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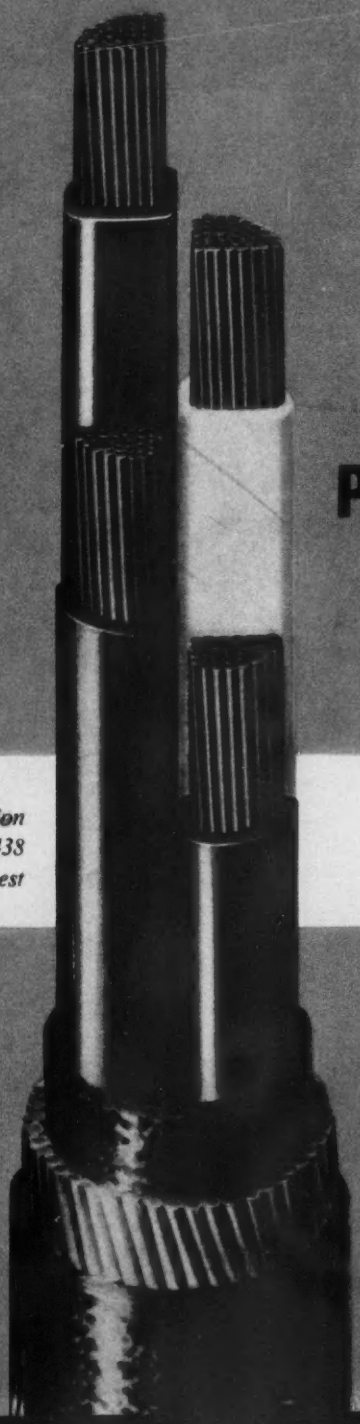

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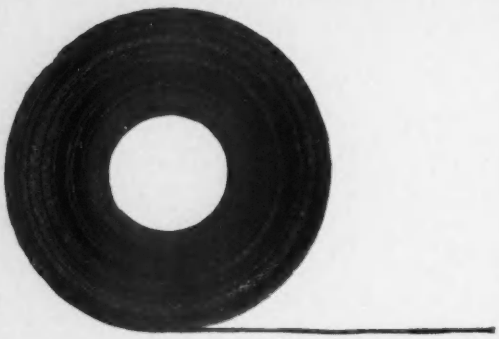

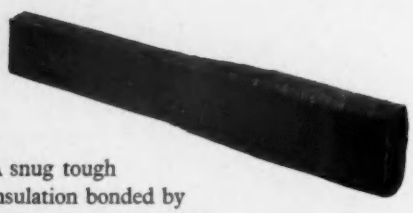

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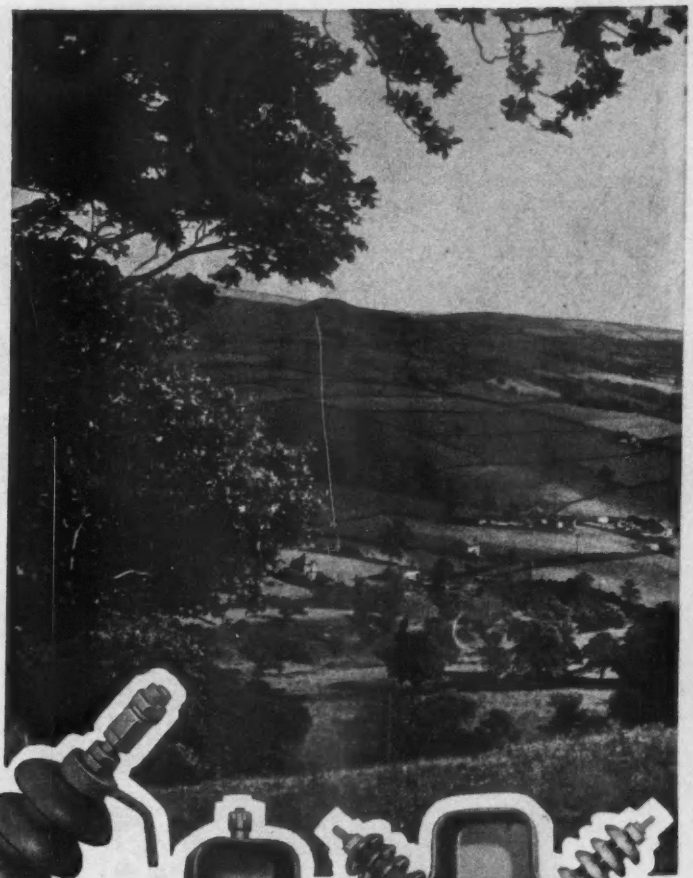

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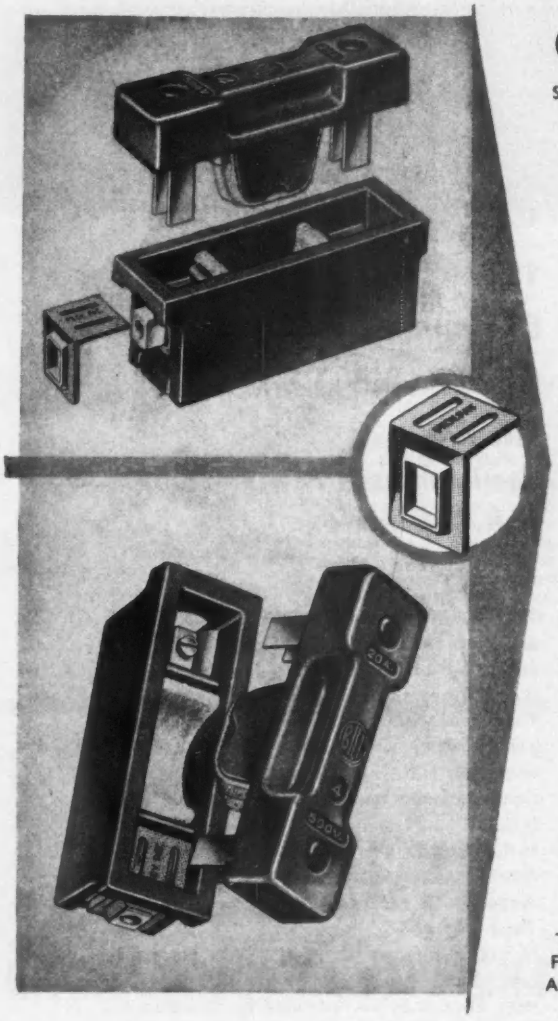

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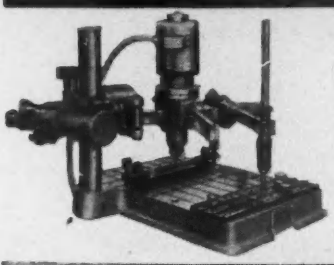

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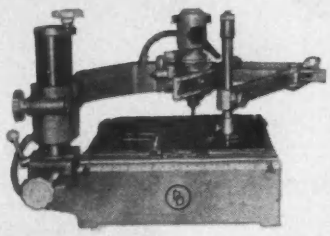

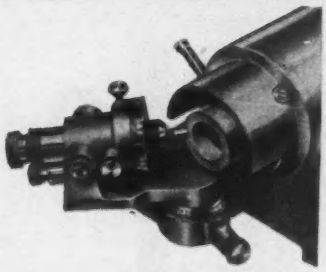

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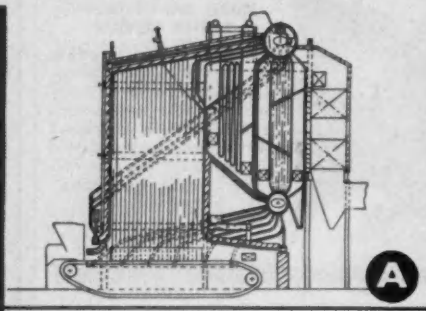

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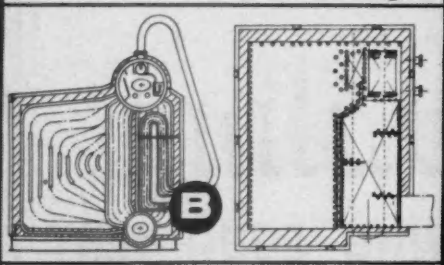

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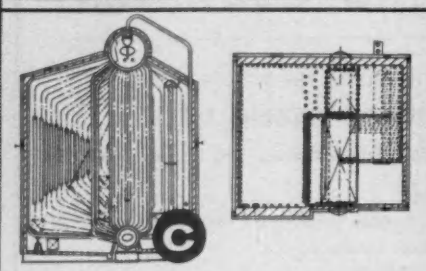

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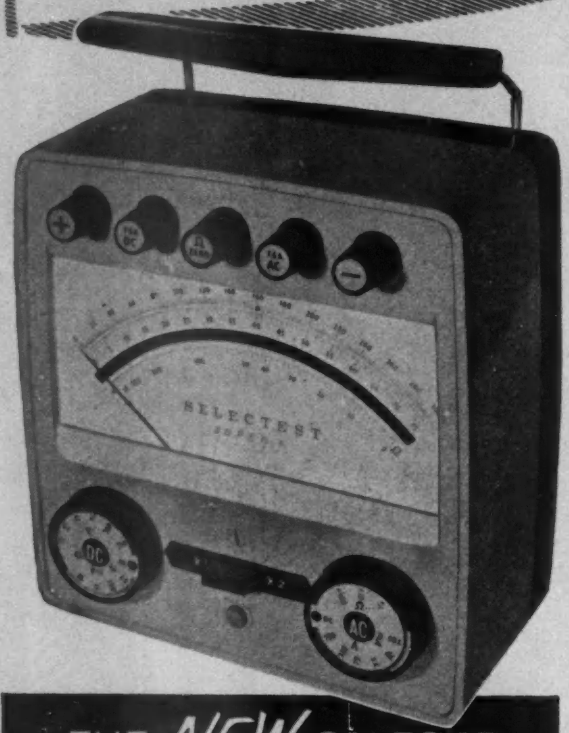

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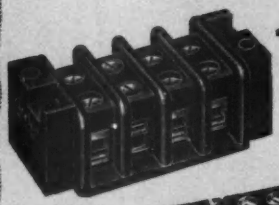

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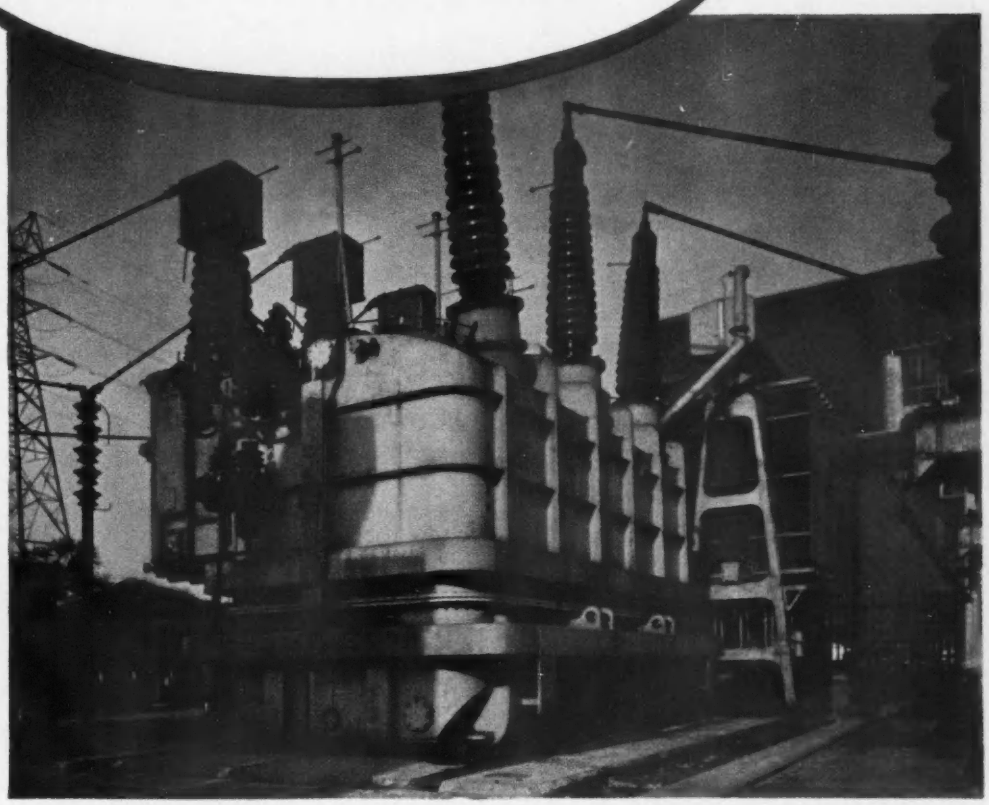

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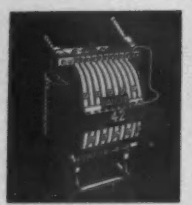

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1927 Largely due to the efforts of Ferranti Ltd., three phase transformers adopted as standard by Central Electricity Board for British Grid System.

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1959 First order placed by Central Electricity Generating Board for 310,000 kVA, 306,000 volt Transformers.

1960 First order placed by Central Electricity Generating Board for 400,000 kVA, 380,000 volt Transformers.

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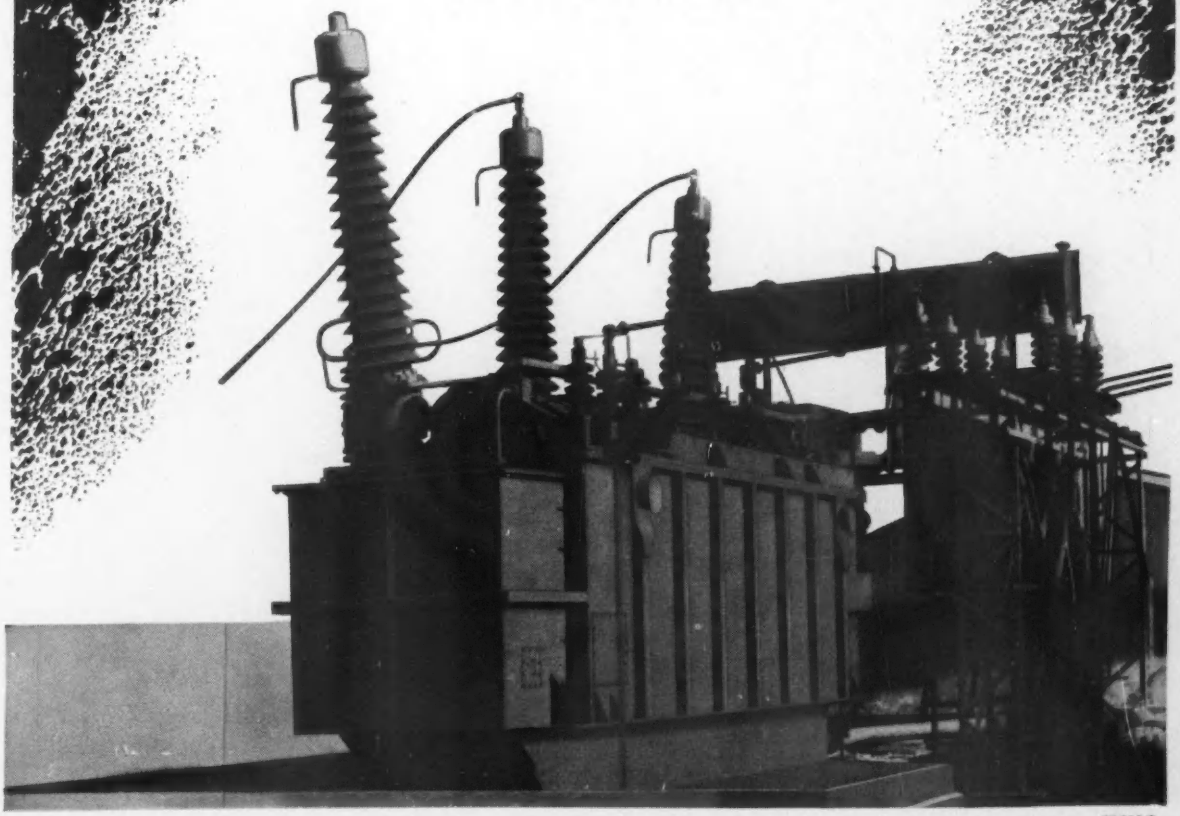

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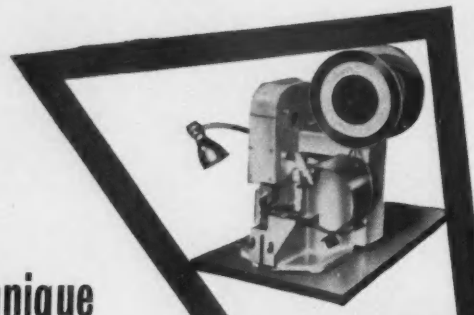

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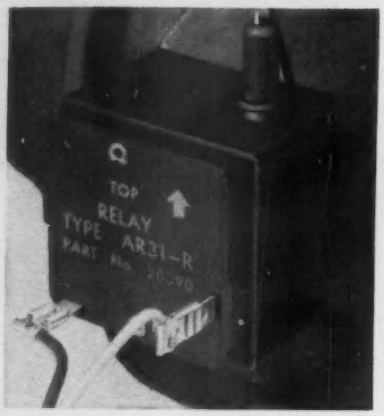
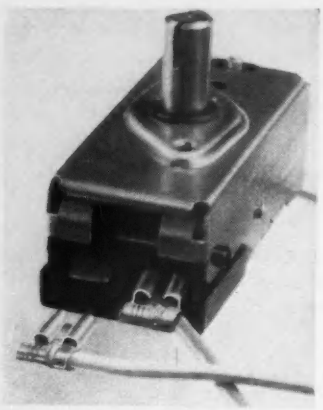
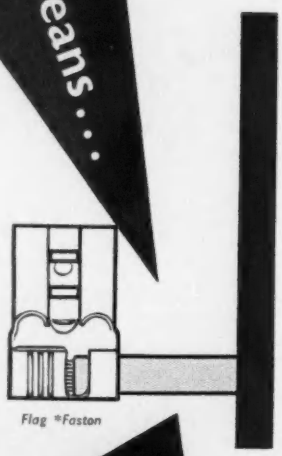


Fastons as applied to domestic refrigerator control.





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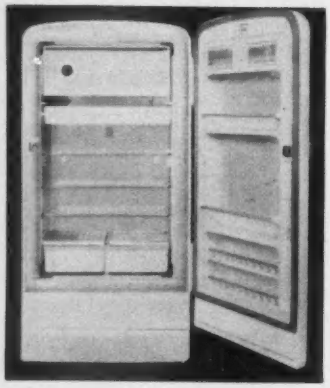

G.E.C. Refrigerator 8 cu. ft. capacity, Faston Connector Technique.

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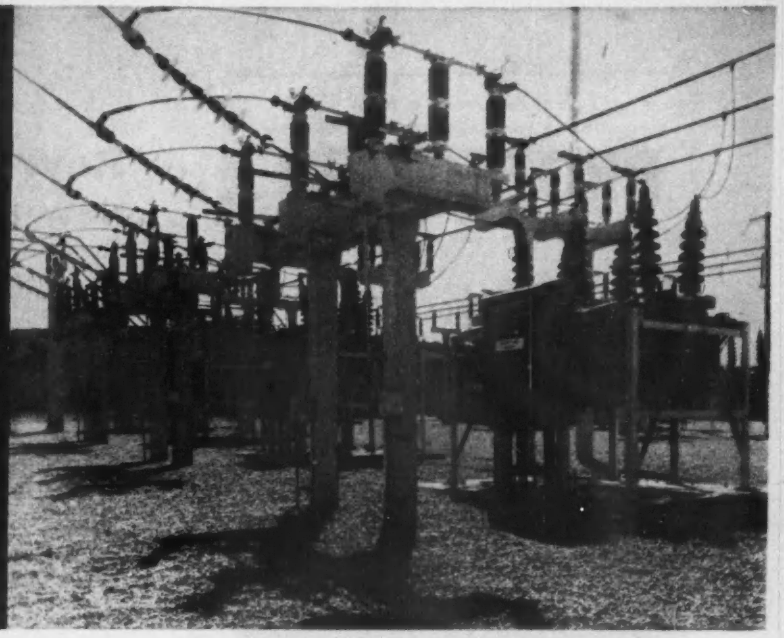

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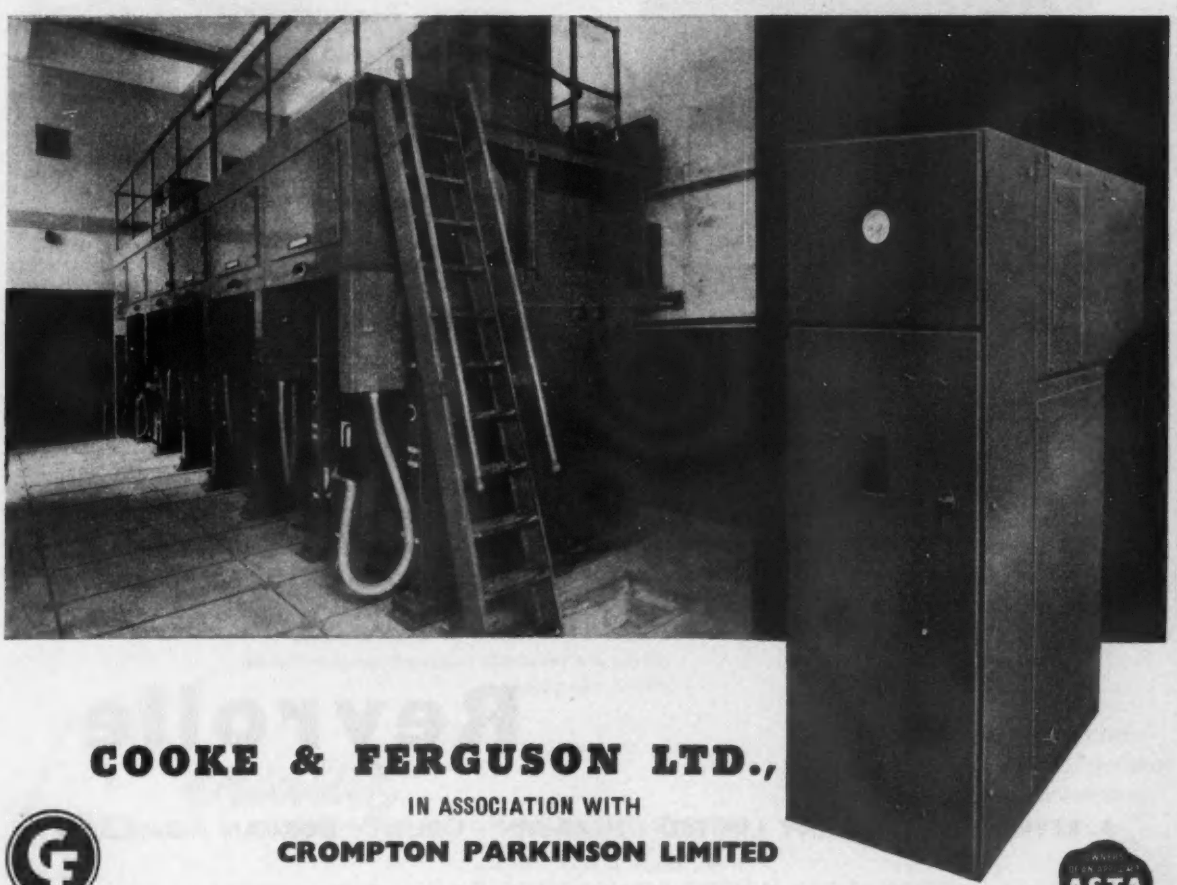

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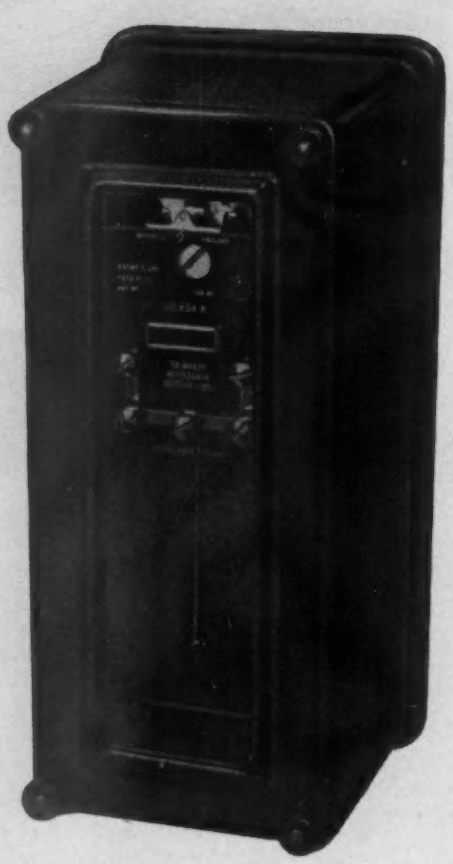


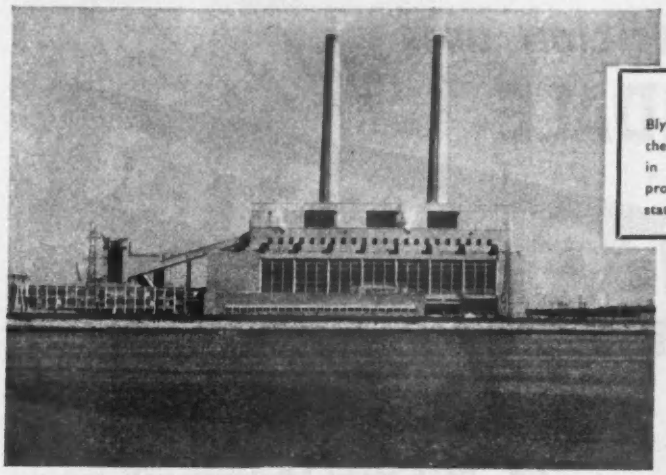
This system is a major advance in the art of feeder protection. It combines the most recent results of protection research with principles which have been well proved in service. Requiring only a single-pole relay and lightly insulated 2-core pilots it is both simple and economical to install, and, being based on static components, its maintenance costs are negligible.

Other features are high-speed operation, high transient stability, low fault-settings, use of ordinary current-transformers, and suitability for pilots up to 1,000 ohms resistance.

Ask for Pamphlet No. 1328

Reyrolle

A. REYROLLE & COMPANY LIMITED - HEBBURN - COUNTY DURHAM - ENGLAND



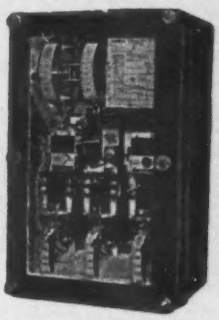
Blyth A Power Station

Blyth A Power Station had a higher thermal efficiency during the year ended 31st March, 1960, than any other power station in Great Britain. The motors driving the auxiliaries are protected by P & B Golds relays in this and many other power stations of the Central Electricity Generating Board.

C·E·G·B chose P & B Golds protection

Consulting Engineers-Messrs Merz & McLellan

P & B Relays give full protection for motors with any starting periods or currents under extremes of ambient temperature.
P & B Golds Relays protect against phase failure, overload, short circuit or earth fault.
P & B Stalling Relays give complete protection against stalling under all conditions. Send for current literature.



P&B PROTECTION RELAYS

THE P & B ENGINEERING CO. LTD
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THE IDEAL SPACE HEATING SYSTEM FOR NEW HOUSING DEVELOPMENT.

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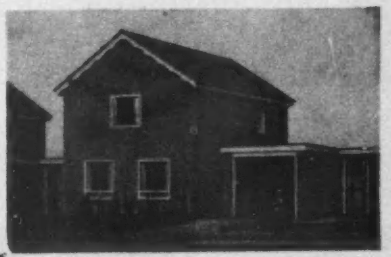

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Quotations and specifications provided on receipt of scale plans and full constructional details. Monitoring equipment available for use during screeding operations.

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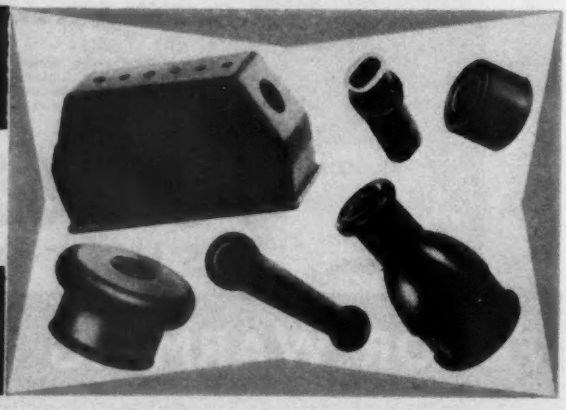

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THE ONE PIECE COMBINATION OF CLIP AND NAIL (OR DRIVESCREW)

FOR USE ON WOODWORK, HARDBOARD, BRICKWORK*, CONCRETE*, PLASTER* etc.

* ONLY ONE PLUG REQUIRED

From your usual supplier, or write to:

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FASTER NEATER CHEAPER CABLE INSTALLATION

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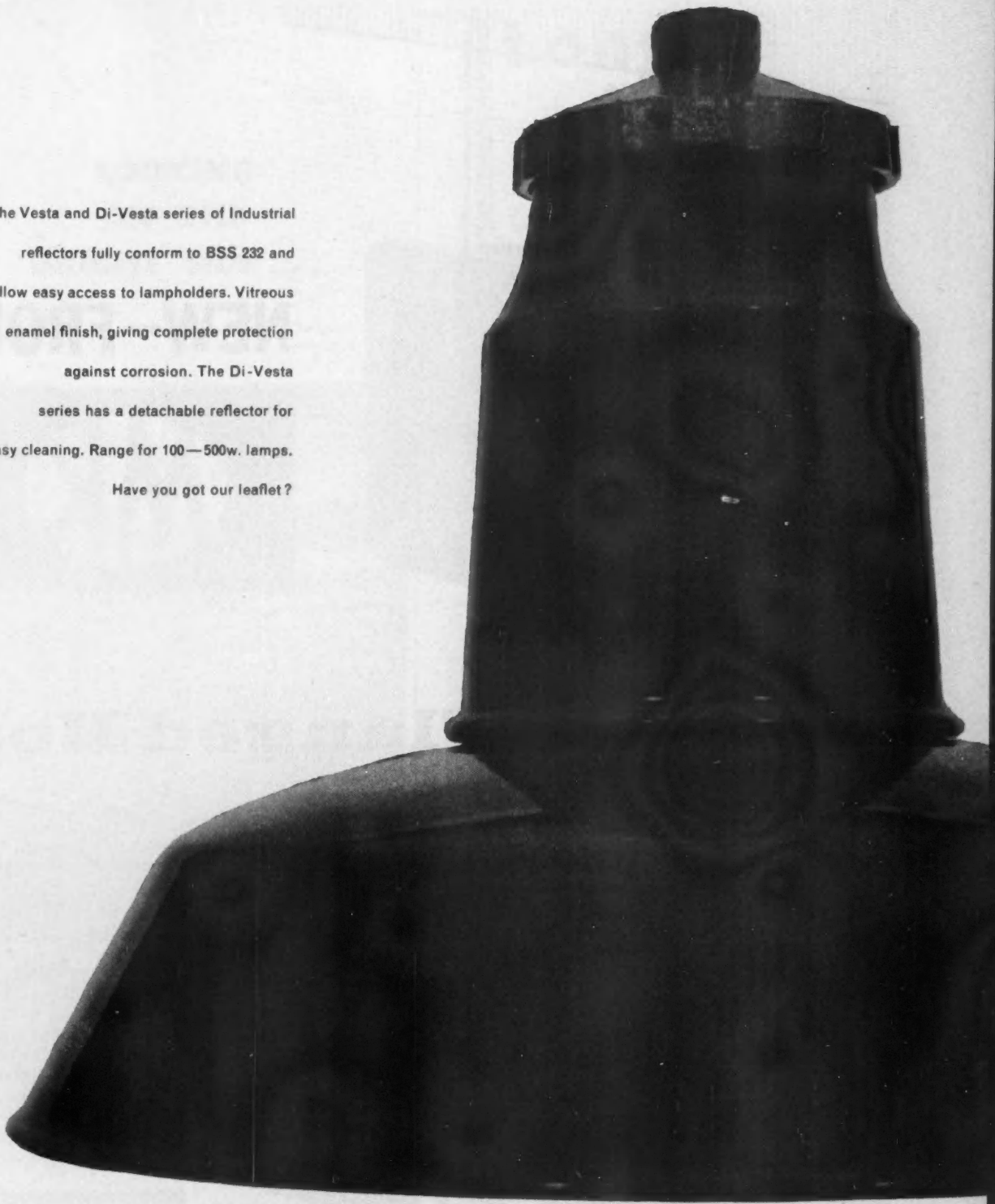
. . . The Vesta and Di-Vesta series of Industrial reflectors fully conform to BSS 232 and allow easy access to lampholders. Vitreous enamel finish, giving complete protection against corrosion. The Di-Vesta series has a detachable reflector for easy cleaning. Range for 100—500w. lamps. Have you got our leaflet?



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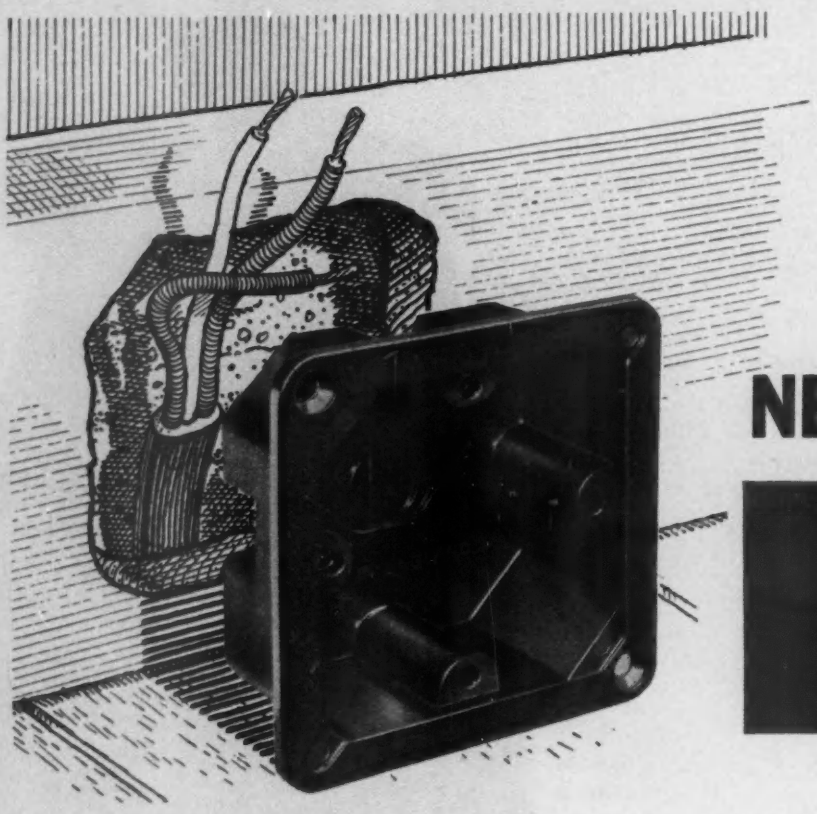
W O W 63

MK200



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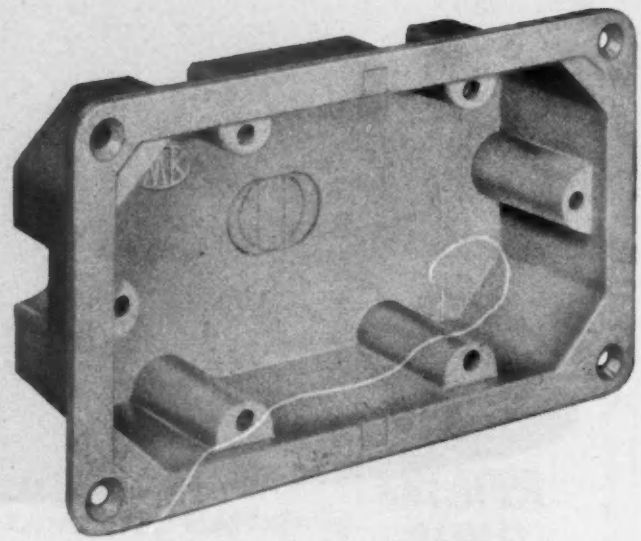

Please ask for Leaflet 257

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LOOKING ON THE BRIGHT SIDE . . .

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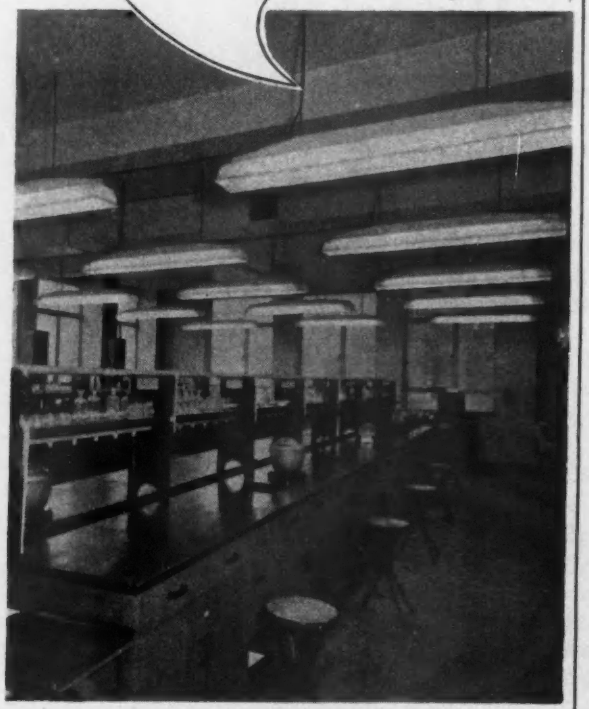

The answer to corroded acid-eaten lighting units —Fibre Glass. Here is a laboratory installation of Troughs manufactured in fibre glass—Top channel and reflector of fibre glass, one or two 80-watt lamps, control gear in an accessible sealed compartment, lamp-holders and mains plug and socket protected by rubber sleeves.

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The Cobra injection process being used in the treatment of implanted poles.

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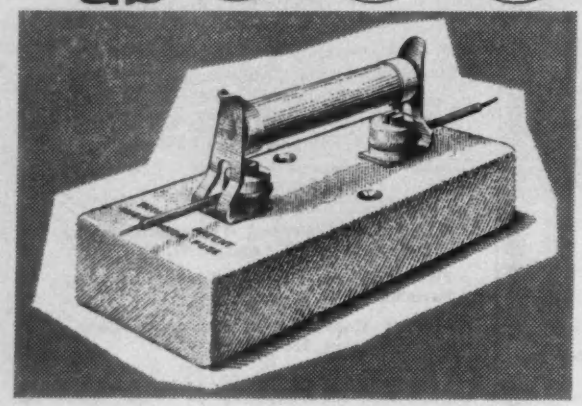
Fuse for thought-

1893

1961



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The H.T. fuse above, was invented by a Mr. Mordy and introduced by The Brush Company in 1893. Since that time, as distribution systems expanded, the problem of providing fault protection at low voltage has involved designing a more ingenious device! To-day, high breaking Capacity Fuse-Links by Brush incorporate these advantages:

* *The high speed of operation ensures that heavy fault currents are cut off before peak values are reached and the stresses on equipment are thus reduced to a safe figure.*
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* *Deterioration of the fuse element is prevented by complete enclosure.*
* *There is no external arc or disturbance during operation and arc voltage rise is restricted.*
* *They are compact and inexpensive and may be used to give protection to existing equipment of low breaking capacity, thus avoiding costly replacement.*
* *They are accurately calibrated and give reliable discrimination between themselves and with other protective devices.*

Brush CARTRIDGE FUSE-LINKS for Industry—800 amperes

Inter-service—¼ ampere–150 amperes. Home Service Cut-out 5-100 amperes. The full range A.S.T.A. Certified to BS 88/1952

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NEWS SHEET

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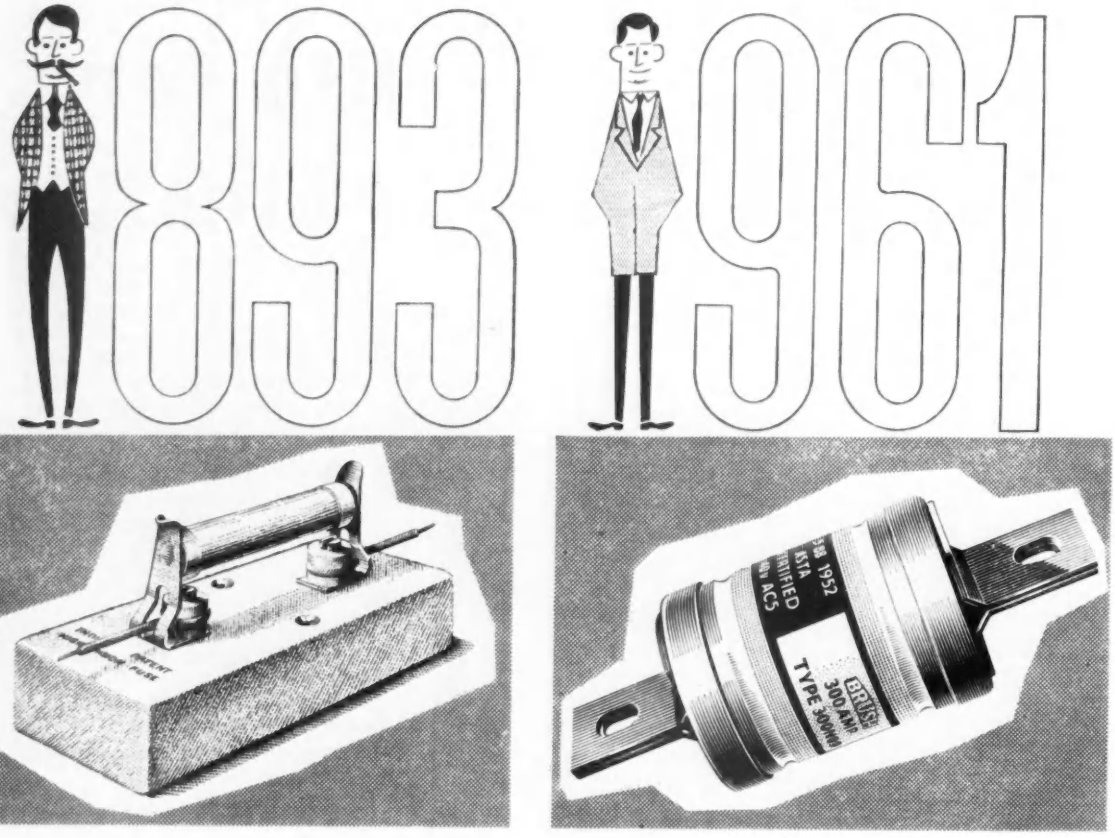

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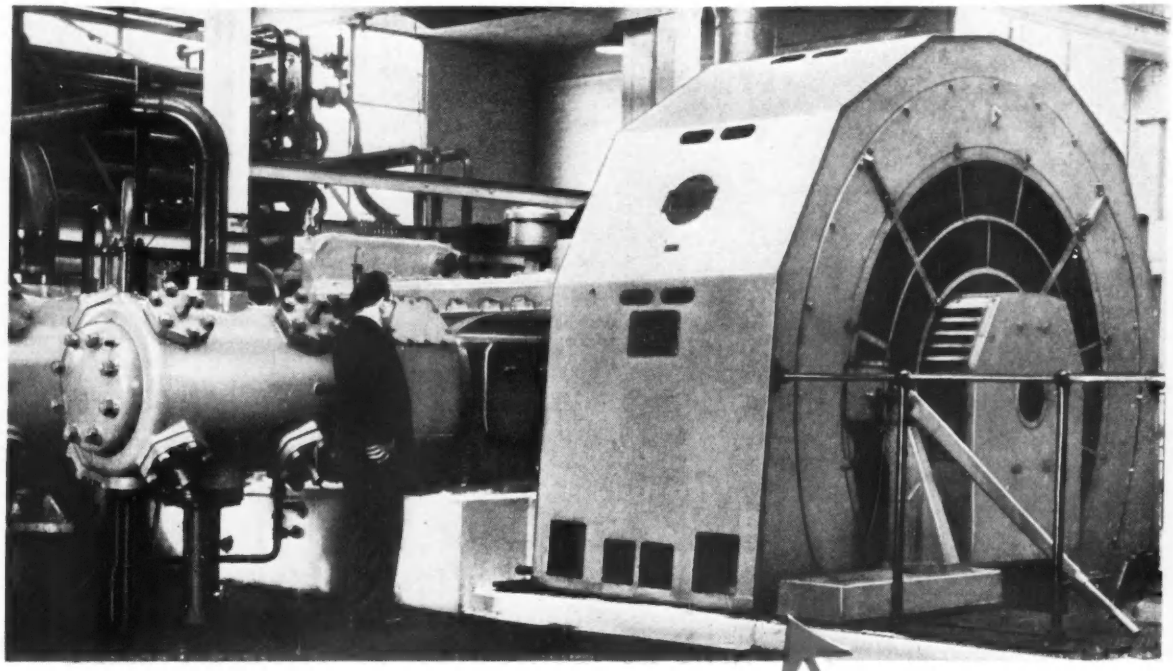

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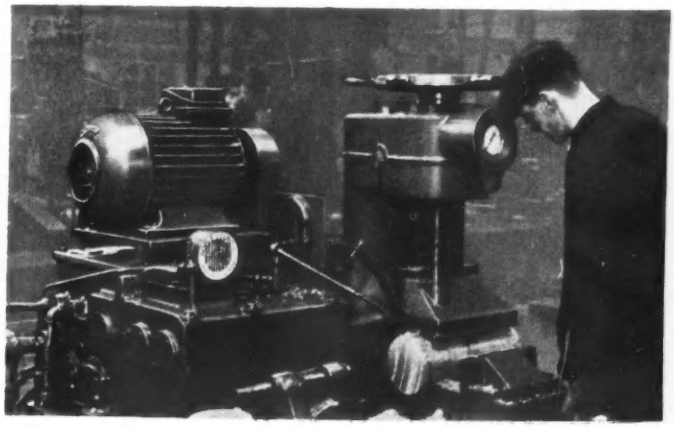

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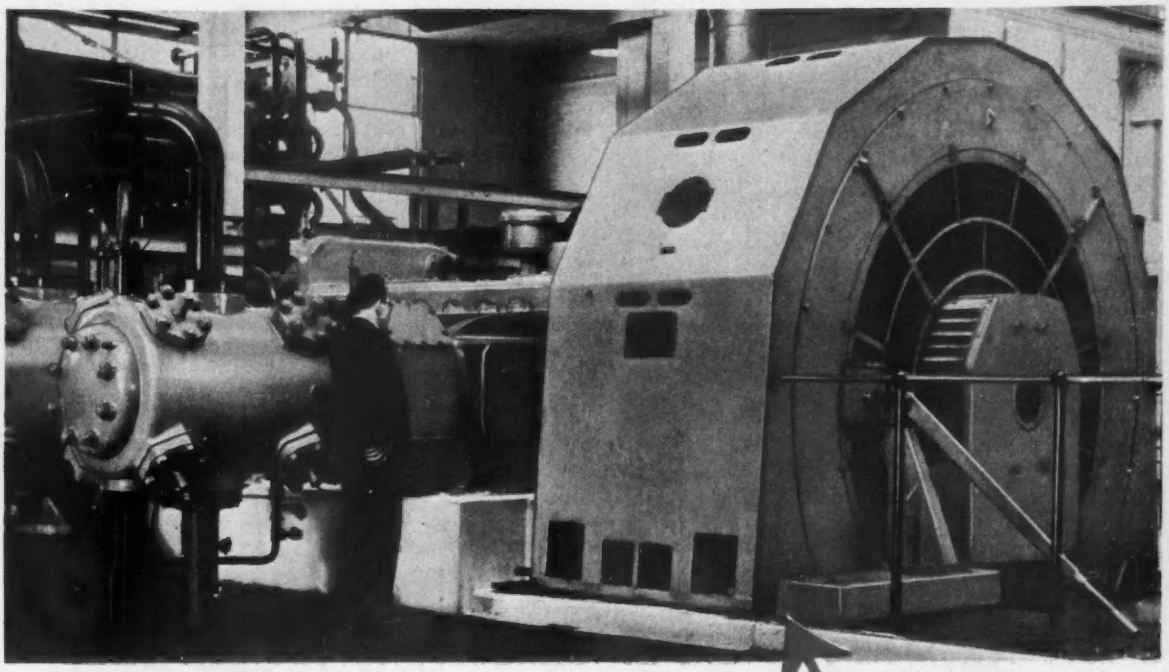

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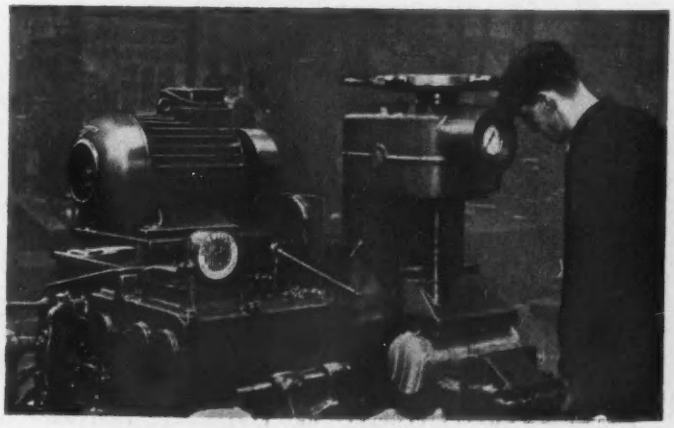

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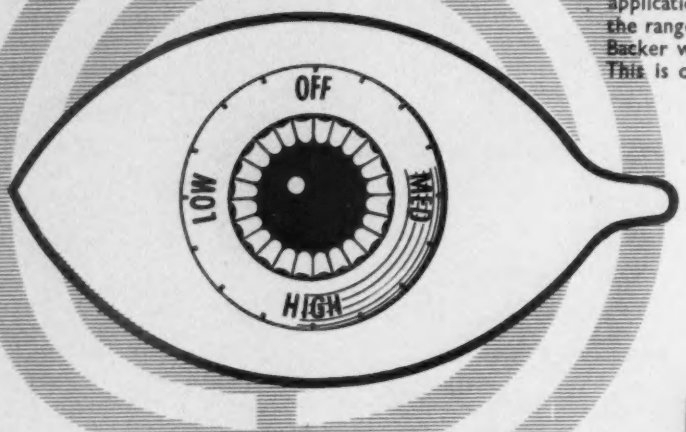

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Visit us on STAND C2 at the A.S.E.E. Electrical Engineers Exhibition, EARLS COURT. March 21st—25th, 1961

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the original continuously-adjustable autotransformer

with the Exclusive

Duratrak
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This model, rated at 4·2 kVA, gives a voltage range of 0-270 volts at 15/17·5 amperes from a 240-volt supply.

A compact design weighing only 50 lb., it can be supplied in open form for panel mounting, ganged, motorised and oil immersed when required.

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ZENITH WORKS VILLIERS ROAD WILLESDEN GREEN LONDON N.W.2
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The Sterling range of insulating varnishes is now augmented by COLDFLO—the solventless, cold flowing varnish which gives perfect penetration without pre-heating. Already established in the field. We shall be pleased to submit samples on request.

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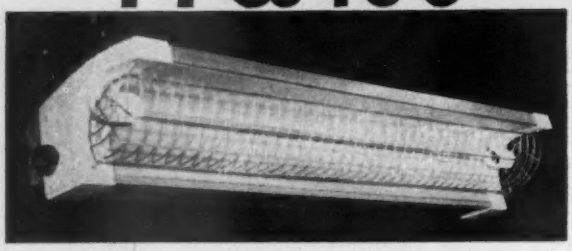
ST 29

NOW

Thermodare presents two domestic Infra-red heaters

WarmWave 77 & 100



The WarmWave 77 and 100 are already setting a new standard in domestic heating! Inexpensive, elegant and efficient, these brilliant new heaters can be mounted in bathroom, kitchen, nursery—any room where instant, safe warmth is needed. The WarmWave directs a beam of heat exactly where it is needed—and because the beam heats only the objects it touches and not the air around, there is absolutely no waste of heat.

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Remember—specify WarmWave

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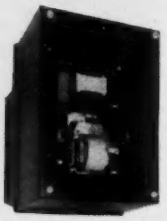

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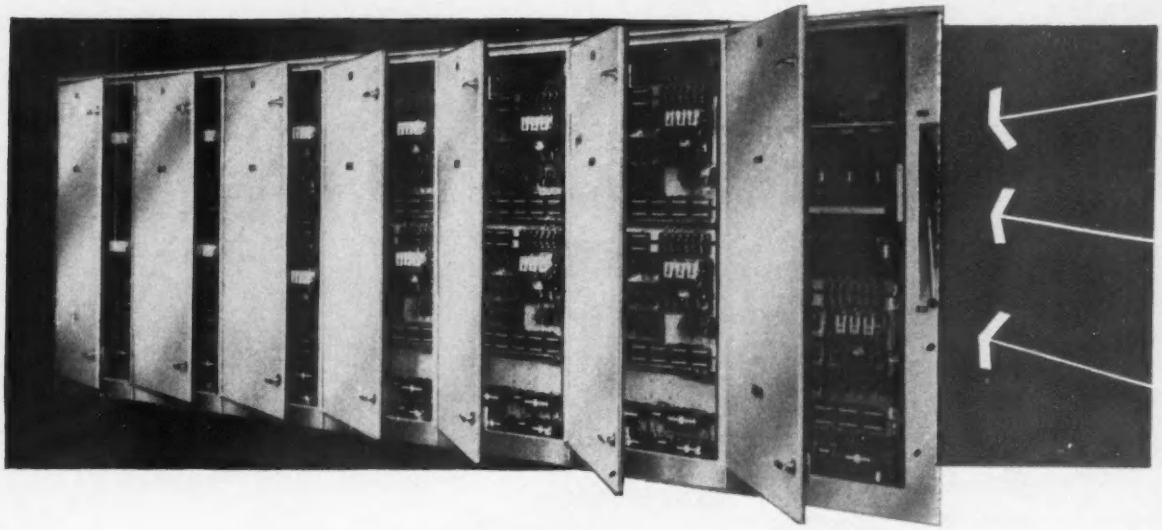
SPECIAL PURPOSE CONTROL PANELS



BY DONOVAN

This SPECIAL 7-door section of a 13-door Transfer Machine control panel may look like any other switchboard BUT—

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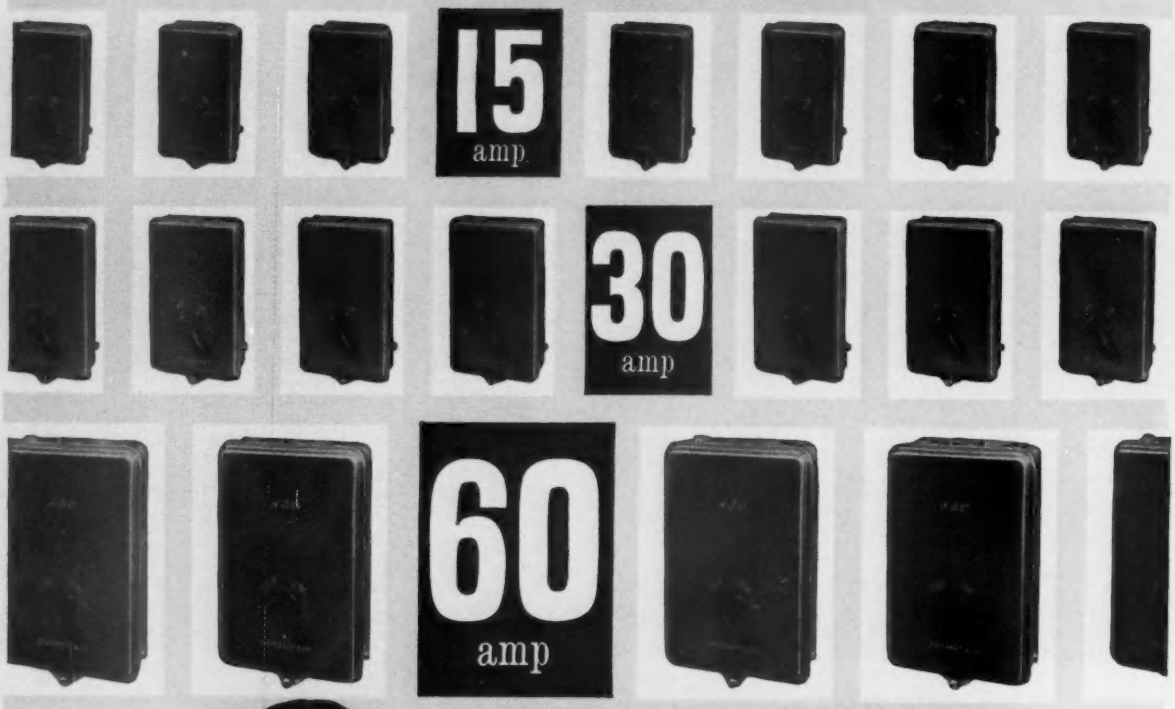
Sales Engineers available in LONDON, BIRMINGHAM, MANCHESTER, GLASGOW, BELFAST, BOURNEMOUTH

"HIDUTAC" switchfuses for



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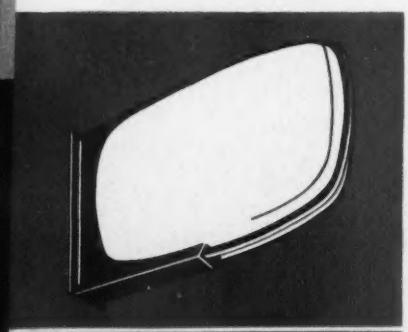
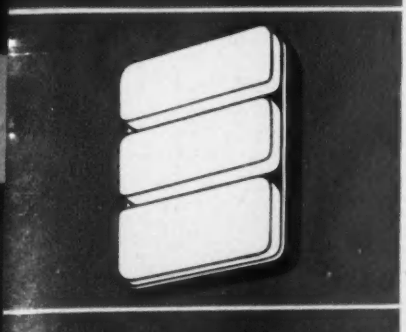
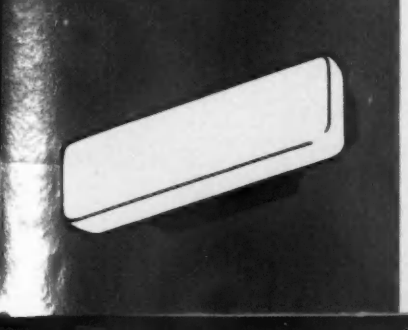
READY-MADE SIGNS FOR EVERYONE

-AND READY-MADE PROFITS FOR YOU !







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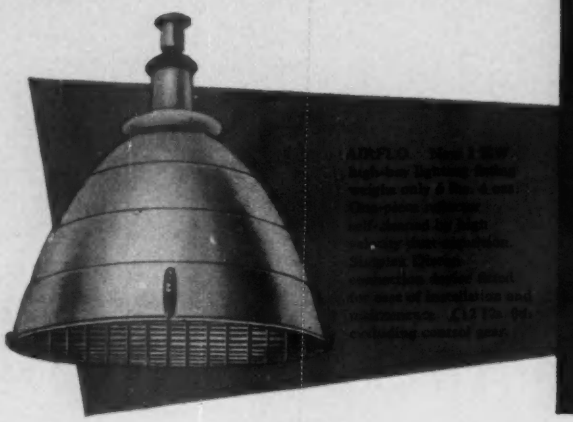

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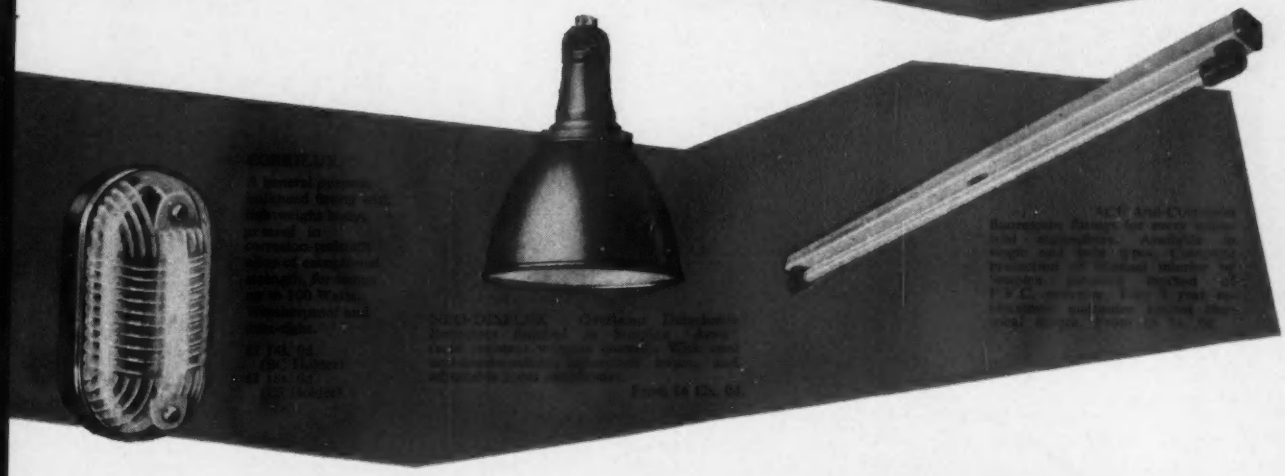
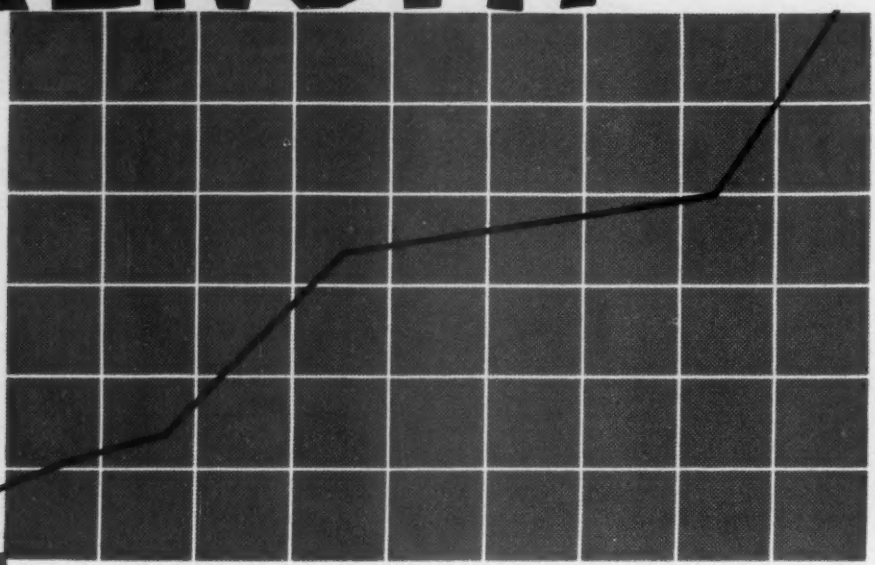


see the Simplex range

REFLECTOR AND DISCON HAVE BEEN ACCEPTED BY THE COUNCIL OF INDUSTRIAL DESIGN FOR 'DESIGN INDEX'.

INDEPENDENCE MEANS STRENGTH



WANDLESIDE · CABLES

Over the years, we have built up a business and a reputation in the cable world which for quality, service and reliability, is second to none.
From small beginnings, by hard work and intensive research, we have grown into the largest independent cable Company group in Great Britain. It is our intention to continue on these lines, growing by our own independent efforts, and relying on our unsurpassed quality and service to enhance our reputation.

Our factories are served by the most up-to-date equipment and meet with Government approval . . . the two factories in Northern Ireland have been granted official D.G.I. approval. Our existing contracts cover almost every branch of engineering, industry, transport, television, atomic energy and illumination throughout the world.

We look forward to the future with confidence and enthusiasm.

Through our combined Research Projects, the group has designed and marketed:

WANDOVERPLAS: The Pioneer Plastic Insulated Overhead Wires System.

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BROODAWARM: Heating Cables for Chicken Broiler Houses.

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WANDLESIDE CABLES

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Fluorescent tubes the nearest thing to daylight

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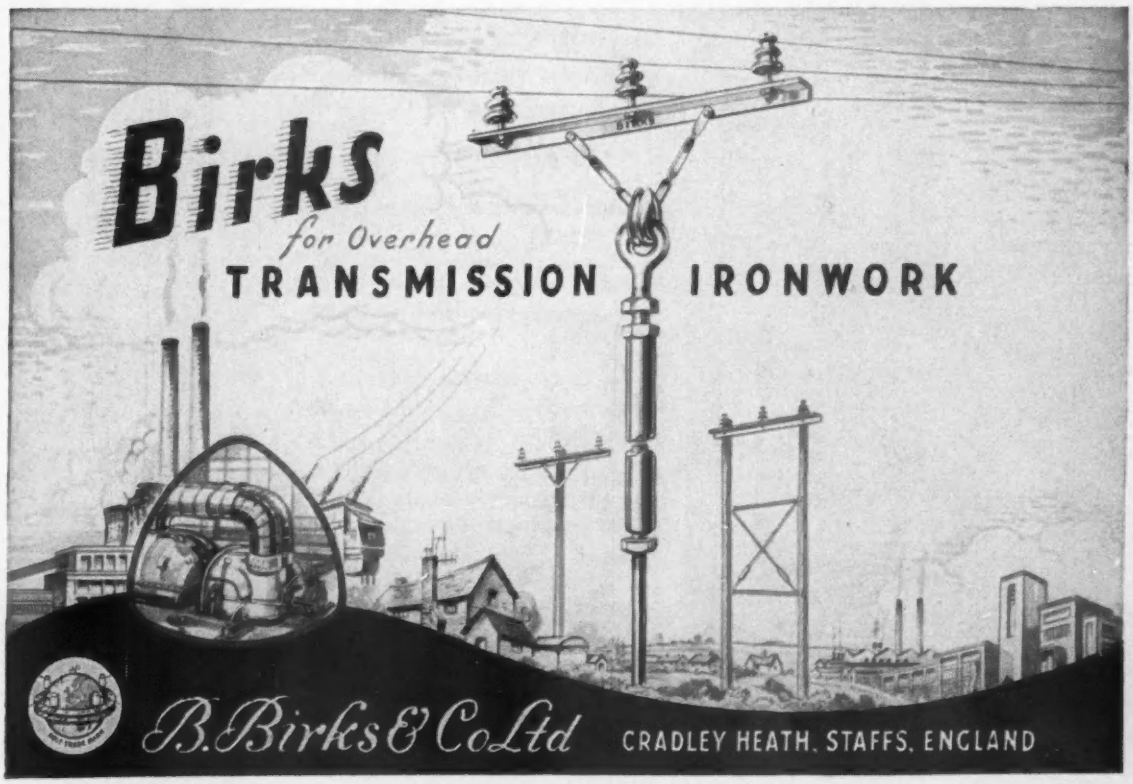
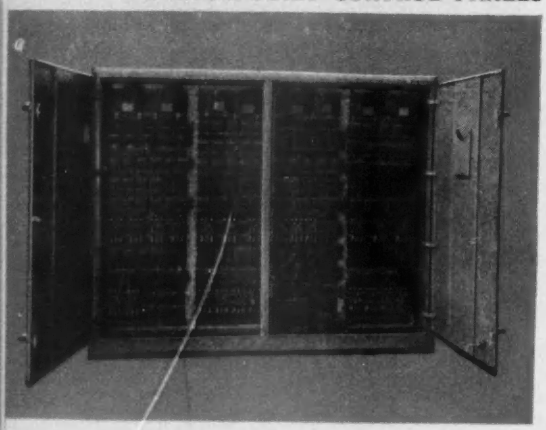
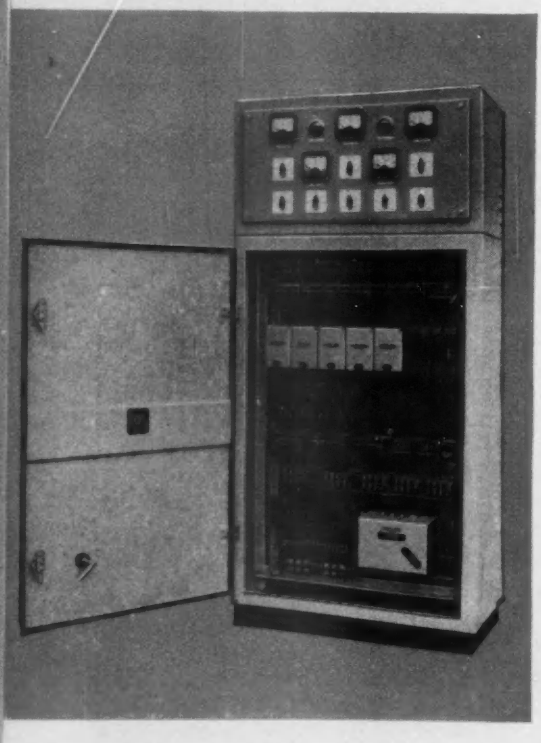
Tele: TERminus 7842 (4 lines). *'Grams:* Contube Kincross London. *Cables:* Contube London



Whichever way

CUSTOM-BUILT CONTROL PANELS





If ever there was a case of "no set answer" it is in the field of automatic controls.

You may require custom-built control panels, or you may prefer to build up your own control systems from individual **M.T.E.** components, chanel framework and standard cabinets.

Whichever way you look at it, you'll find that **M.T.E.** 'double-service' is the answer.

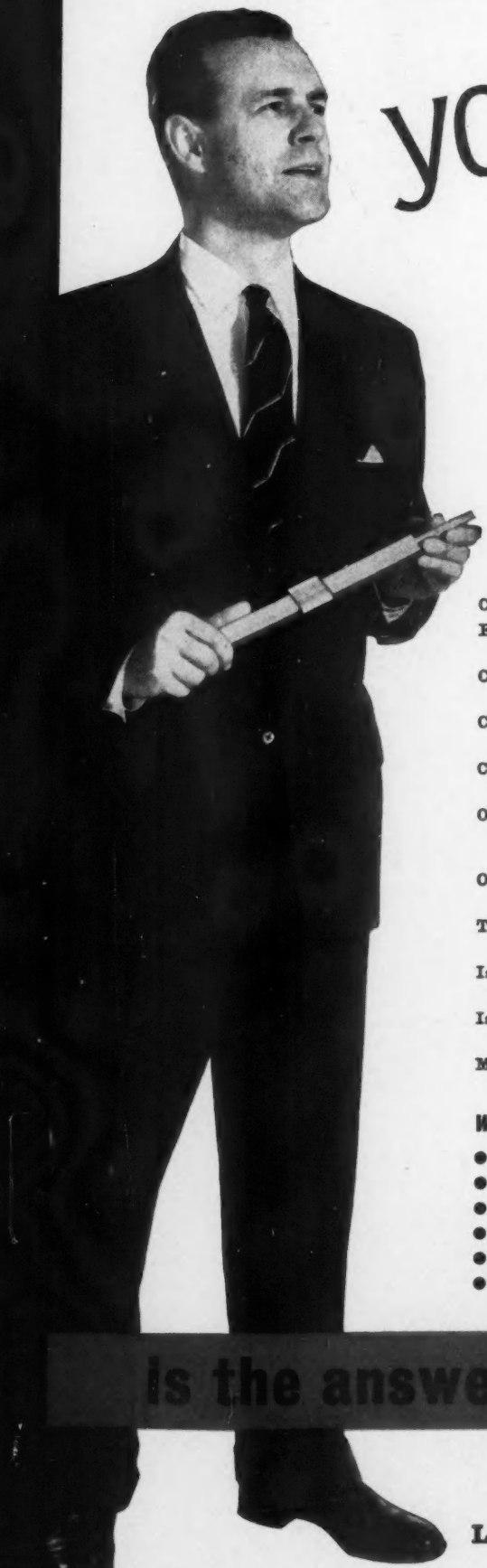
Top left:
Control panel for eight-head rotary indexing machine.

Lower left:
Control panel for industrial refrigeration plant.

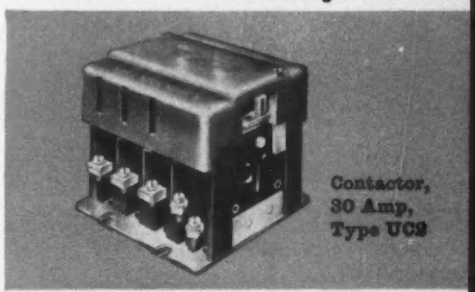
MTE 'DOUBLE-SERVICE'

M.T.E. CONTROL GEAR LIMITED

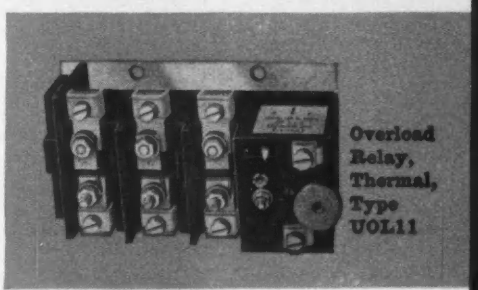
you look at it



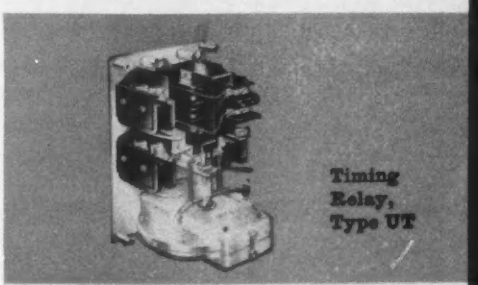
COMPONENTS IN DOUBLE-QUICK TIME



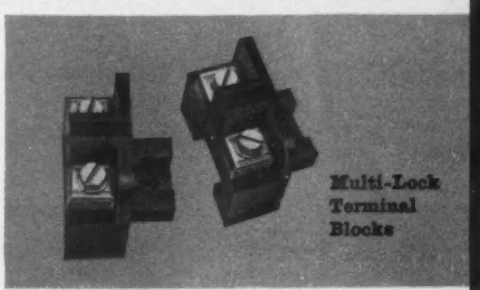
Contactor, 30 Amp, Type UC2



Overload Relay, Thermal, Type UOL11



Timing Relay, Type UT



Multi-Lock Terminal Blocks

CHECK THESE DELIVERY TIMES

Eight Pole Relays Type UR1	7/9 days
Contactors, 15 Amp, Type UC2L	7/9 days
Contactors, 30 Amp, Type UC2	7/9 days
Contactors, 75 Amp, Type UC3	7/9 days
Overload Relays, Thermal, with Single Phasing Protection	7/9 days
Overload Relays, Magnetic	9/11 days
Timing Relays, Type UT	13/21 days
Isolating Switches, 40 Amp, Type UIS02	7/9 days
Isolating Switches, 150 Amp, Type UIS03	9/11 days
Multi-Lock Terminal Blocks, 15, 40 & 100 Amp	1/3 days

With these design features—

- UNIT CONSTRUCTION
- COMPACT SIZE
- FRONT WIRING
- HEAVY DUTY
- DOUBLE BREAK
- WIDE RANGE
- BS.775 - 1956
- C.S.A. APPROVED
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is the answer

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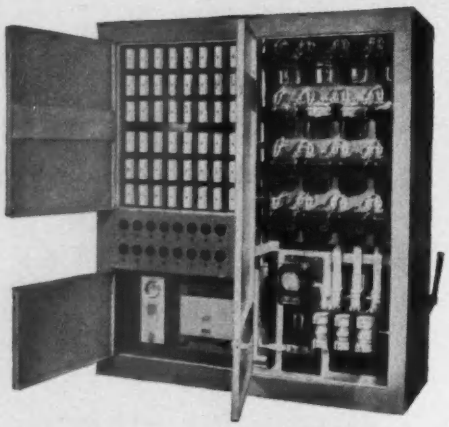
M6

BKS

Heating Control Panels

built to individual Specifications



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With the special off-peak tariffs now available through the electricity authorities the overall cost of thermal storage space heating has been reduced to a most economical figure. We are specialists in the design and manufacture of automatic panels for space heating control and have supplied panels handling up to 500 kW.

The panel illustrated handles 267 kW and is divided into 16 zones with individual limit thermostats and overall control by time-switch, together with anticipatory control unit. We shall be most happy to quote for your automatic control panel.

CONTACTORS

Comprehensive range of contactors for all types of thermal storage and space heating control—10 to 350 amp. SINGLE, DOUBLE, TRIPLE AND FOUR POLE.

FOR SILENT OPERATION. All models can be fitted with D.C. operating coil and rectifier.

Type D10 60. *4-Pole, 60-Amp, in steel housing.*

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Telephone: Chertsey 3467. Telegrams: Switchgear, Chertsey.

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Agents Throughout the World

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To BRITISH KLOCKNER SWITCHGEAR LIMITED

Chertsey, Surrey.

Please send me your list of Contactors for Heating Control.

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POSITION .....

FIRM .....

ADDRESS .....

HCPT

THE

"54"

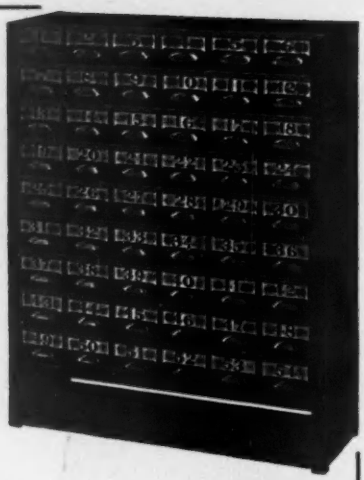
DRAWER UNIT

ALL STEEL
Stove Enamelled
DARK GREEN

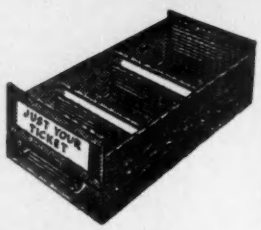
•

OVERALL SIZE
42" HIGH
36" WIDE
12" DEEP

•



Contains 54 of these drawers, each 5" wide, 3" high, 11¼" long. 54 dividers and 54 drawer cards with each unit.
Extra dividers 6d. each.



£18 DELIVERED FREE to ENGLAND, SCOTLAND and WALES

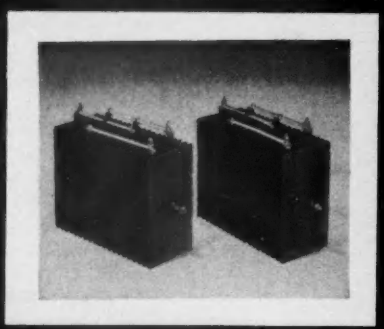
SEND FOR SAMPLE DRAWER

N. C. BROWN LTD.

E.T. WING . HEYWOOD · LANCS.

Telephone: Heywood 69018 (6 lines)

AUTOMAT



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BATTERY CHARGING
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PRINTED CIRCUITS

- *High Efficiency*
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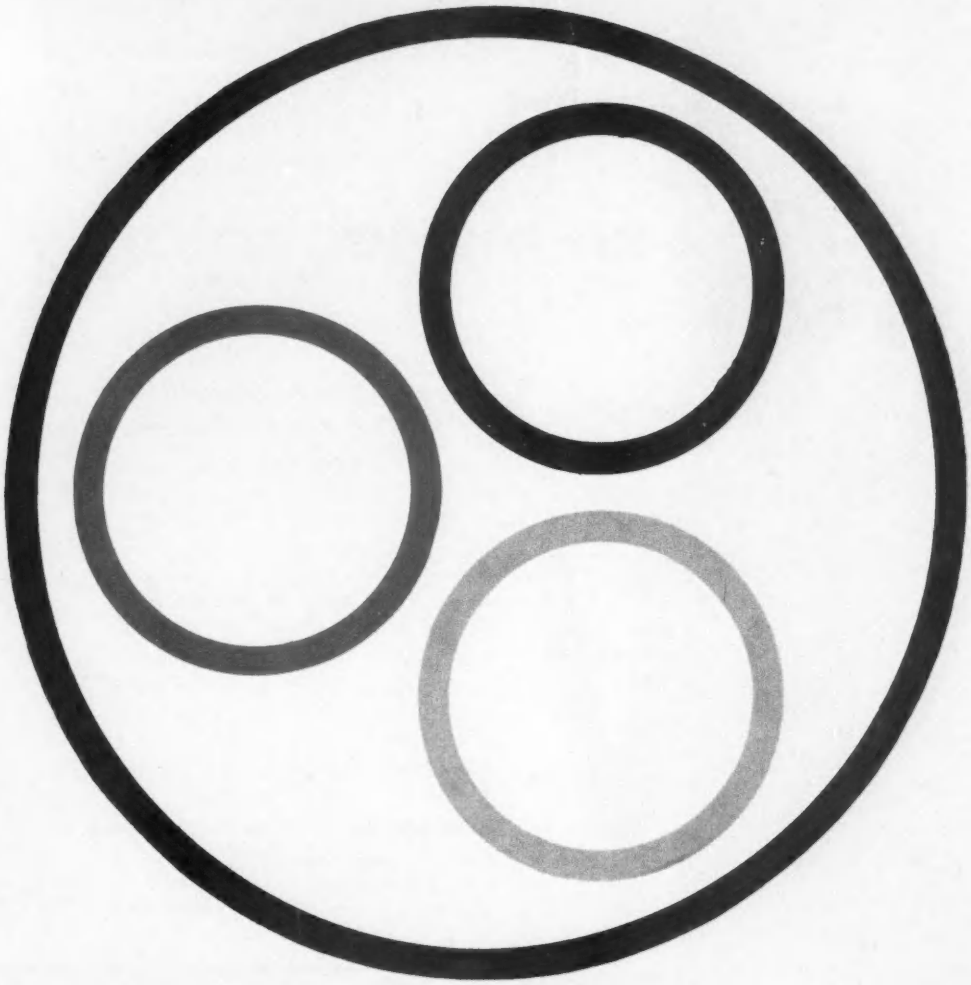

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Plastic Power Cables
Mining Cables

Engineers throughout the electrical and mining industries rely on Glovers Cables, in an ever increasing extent, to provide the vital link between the power station and the supply point. To meet their growing responsibilities these discerning users know that they are installing cables of the highest quality. You, also, can buy with confidence from Glovers – the oldest name in cable making.

BY APPOINTMENT
TO H.M. QUEEN ELIZABETH II
ELECTRIC CABLE MANUFACTURERS

GLOVERS

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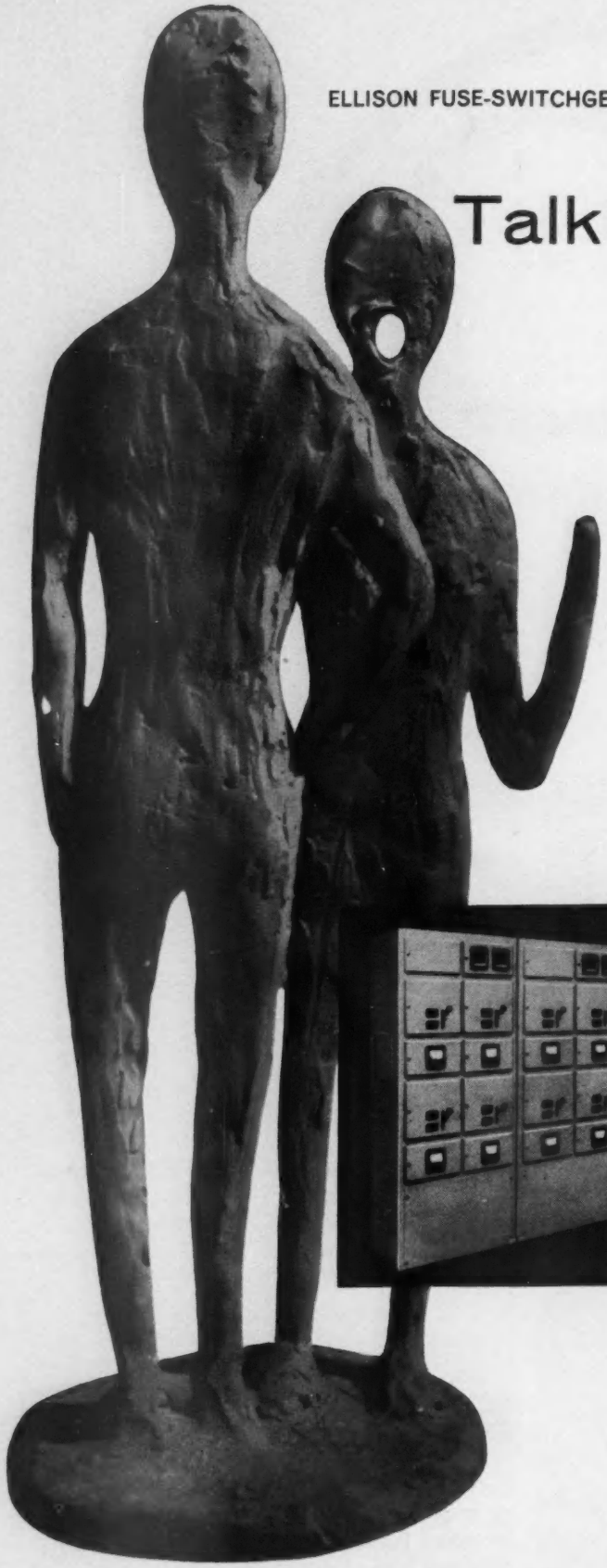
Trafford Park, Manchester 17
Trafford 2141 Telex 66413



ELLISON FUSE-SWITCHGEAR

Talking technically

It has been said that there are lies, damn lies and statistics. Nevertheless, in choosing switchgear one cannot afford to ignore certain technical data that distinguishes good reliable equipment from others.

For this reason we make no apologies for giving the following information concerning "Ellison" Heavy Duty Fuse-switchgear:

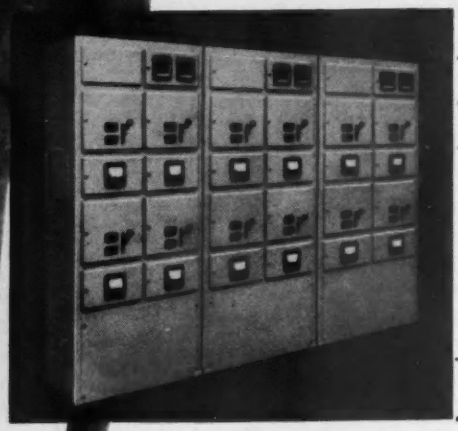
DESIGNED AND TESTED BY US TO B.S.3185:1959 for use with fuses tested to B.S.88:1952, Category AC5.

SWITCH MAKING CAPACITY—46,000 amps at 550 volts, ·15 P.F.

SWITCH BREAKING CAPACITY—3 times the rating at ·25/·3 P.F. at 550 volts.

BUSBAR AND CONNECTIONS—comply with B.S.159:1957.

FUSES—Any make of fuse to B.S.88:1952, Form B, can be fitted.



RATED CURRENTS	
FUSE-SWITCH	FUSED
AMP	AMP
100	2-200
200	2-400
300	2-400
400	350-500
600	350-600
Three-pole or three-pole and neutral link	

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ELECTRICAL TIMES

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Dans ce numéro

Câbles électriques isolés au polythène 201

Les câbles à haute tension isolés au polythène présentent actuellement un grand intérêt car ils permettent d'effecteur des raccordements de façon plus simple que la chose n'est possible avec des câbles isolés au papier. On peut se procurer facilement des câbles isolés au polythène pour tensions de 11 kV, et l'on espère pouvoir aussi les utiliser à la place des câbles isolés au papier pour les tensions de 33 kV. Un câble à âme unique isolé au polythène et destiné à un tension de 44 kV a subi avec succès toutes les épreuves auxquelles sont soumis habituellement les câbles, ainsi que des épreuves ayant pour but de déceler la présence éventuelle de vides dans le polythène.

Dégâts infligés aux isolateurs par les projections d'étincelles 205

On peut éviter les dégâts causés aux isolateurs par les projections d'étincelles en se servant de cornes d'un type perfectionné. L'expérience a montré que ces nouvelles cornes donnent des résultats satisfaisants, même par grand vent. Les projections d'étincelles sont habituellement causées par la foudre mais, en Grande-Bretagne, l'incidence de la foudre est trop faible pour que l'on soit fondé de modifier les isolateurs actuels en les dotant de ces nouvelles cornes perfectionnées. Il est possible que dans d'autres pays une telle modification s'avère opportune du point de vue économique.

Redresseurs reglé au silicium 216

Les redresseurs reglé au silicium en usage à l'heure actuelle prévoient des tensions de crête de 600 V, et tolèrent des tensions transitoires atteignant 1.200 V. La perte de charge à l'avance est d'environ 1,1 V et les variations de température tolérées sont de 120°C à 200°C. Le débit prévu est fonction de la température enregistrée à la jonction du semi-conducteur, et il est déterminé par le dispositif de refroidissement envisagé. Les redresseurs au silicium peuvent s'employer par groupes montés en série ou en parallèle. On est en train de mettre au point des redresseurs capables de fonctionner à des températures atteignant 500°C.

In dieser Nummer

Kunststoffisolierte Starkstromkabel 201

Kunststoffisolierte Starkstromkabel für Hochspannungen sind gegenwärtig gefragt, da sie einfachere Verbindungskonstruktionen ermöglichen, als es bei papierisolierten Kabeln der Fall ist. Kunststoffisolierte Kabel sind für Betriebsspannungen von 11 kV kurzfristig zu beziehen und versprechen einen praktischen Ersatz für papierisolierte Kabel für Betriebsspannungen von 33 kV zu werden. Ein kunststoffisoliertes Einleiterkabel für 44 kV hat sämtliche üblichen Kabelprüfungen einschließlich Prüfungen auf Poren im Kunststoff bestanden.

Beschädigungen an Isolatoren durch Lichtbögen ... 205

Beschädigungen an Isolatoren durch Lichtbögen können durch Verwendung verbesserter Lichtbogenhörner vermieden werden. Untersuchungen haben ergeben, daß diese Lichtbogenhörner selbst bei starken Winden ihrem Zweck entsprechen. Lichtbögen werden gewöhnlich durch Blitze verursacht, jedoch ist in Großbritannien der Blitzeinfall zu gering, um die vorhandenen Isolatoren auf den verbesserten Stand zu bringen. In anderen Ländern mögen Abänderungen wirtschaftlich gerechtfertigt sein.

Silizium-Gleichrichter 216

Die gegenwärtig zur Verfügung stehenden Silizium-Gleichrichter liefern Gipfelspannungen von 600 V und haben Vorkehrungen für Stoßspannungen bis zu 1.200 V. Der Vorausspannungsabfall liegt bei 1,1V un die zulässige Temperatur schwankt zwischen 120° C bis 200° C. Die Strombemessung bezieht sich auf die Temperatur an der Halbleiterverbindung und wird durch die vorhandenen Kühlvorkehrungen bestimmt. Silizium-Gleichrichter können in reihen- und parallelgeschalteten Kombinationen verwendet werden. Gleichrichter zum Betrieb bei 500° C befinden sich in der Entwicklung.

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Planning future extensions?

Early planning ensures economic, efficient and effective boiler plant

Right at the outset, when new boiler installations have to be considered, consultation with IC boiler engineers helps to resolve the problems of selecting the most suitable plant. The importance of early discussions about boiler plant cannot be over emphasized. Selection of operating conditions, boiler output, the choice of fuel, method of firing, and the site limitations, are but a few of the basic problems which can be resolved by early planning. Take advantage of this IC service, backed by world wide experience, design, research, manufacturing, and installation facilities.

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ELECTRICAL TIMES

ESTABLISHED 1891

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Comment

WARRANTY

The time has come for manufacturers to revise basically the guarantees they offer on their goods. In the past, over-zealous efforts by those who drew up the standard forms of guarantees in common usage have led to the inclusion of express terms which often bar the purchaser from relying on the protection that might otherwise be available to him at law. As a result, the purchaser may have fewer safeguards with the guarantee than without it. All such clauses in manufacturers' guarantees are now coming under attack from the BSI Consumers' Advisory Council, and the sooner they are scrapped the better. Their inclusion is little more than habit (often by copying), and most reputable firms do not hesitate to go beyond the terms of written guarantee if necessary to protect their reputation. Nor would the terms be valid in many cases since it is a common experience of manufacturers to receive back only some 50% of the cards sent out with the goods. What is more, that figure is likely to fall under the criticisms now being levelled. This is unfortunate, since if purchasers could be relied upon to return the cards promptly, this information would provide an accurate indication of day-to-day sales, from which an estimate of stocks could be made. With the exigencies of Government economic control, and as production runs of equipment lengthen, such information of sales levels is vital. There should therefore be the strongest inducement to manufacturers to make their guarantee cards of real value, so that the purchaser, or perhaps the retailer, cannot afford to neglect their return. Certainly there is no reason to retain the restrictive clauses a day longer than existing stocks of printed cards.

COMPETING FOR NUCLEAR ORDERS

With orders for nuclear power stations appearing to be awarded to the decreasing number of nuclear consortia on a rotational basis, the complaint often heard against the expense of preparing competitive tenders is readily understandable. The point was raised once more last Friday in the House of Commons during a somewhat discursive debate on the nuclear energy programme. It met with a most adamant reply from the Ministry of Power spokesman, Mr J. C. George. With an extreme of adherence to the creed that "competition cures all," he quoted the fall in price per kilowatt for the nuclear stations so far ordered (excluding South Scotland's Hunterston) as justification for retaining competitive tendering. One would have imagined that, with the close contact maintained between the CEGB and their consultants, the UKAEA, on the one hand and the consortia on the other, and with

the machinery of pre-tendering conferences and briefing that has been established, something less than full competitive tendering might be possible without serious loss of technical and economic advance. It is not helpful to do as Mr George did in the debate and point out that tender costs are only a fraction of one per cent of the total station costs; it is the cost in terms of man-hours of possibly useless effort by engineering and scientific leaders of the various design teams that is so troubling. The negotiations understood to be in progress for a compensatory payment to unsuccessful tenderers would not affect this consideration. A more flexible approach could be hoped for from the Ministry of Power.

POLYTHENE IN POWER CABLES

Polythene has so many attractive electrical qualities that its relatively slow progress as a power cable dielectric is a continuing surprise to the non-specialist. At present, it seems well established for voltages up to 11 kV, but not for everyday applications in any form that shows compulsive economic advantage compared with paper-insulated designs. Manufacturing complications related to the need to prevent void formation, and the cost of the raw material, can offset some of the apparent advantages compared with the more complex paper-insulated cable construction. Currently, it looks as though the cost of polythene may fall, and this will be an important factor favouring extension in use. At present, however, application is mainly dependent on exploitation of one of the special qualities such as light weight (in overhead cables) or relative ease of termination (as in substations where many short lengths of cable are involved). In an article this week, the opinion is advanced that gradual improvement in details of extrusion technique and in associated test work and construction are clearing the way for the next step in voltage, 33 kV, at prices competitive with mass-impregnated designs. Such an advance, though possible technically, may depend on the forms of cable construction most favourable to plastics becoming acceptable in terms of statutory regulations. The experimental work now proceeding in many parts of the country on plastics cables generally will be closely watched in this respect for their effect on e.h.v. polythene designs.

ULTIMATE IN RECTIFIERS

The large audience at last week's IEE meeting on silicon power rectifiers produced surprisingly few members willing to contribute to the discussion of a fact-filled paper. Such a circumstance is not unusual with a comparatively new subject, where there is a feeling that only the specialists have worth-while know-how. However, on this occasion, for all its brevity, the discussion provided plenty of value. Prominent amongst the topics worked over was the need for careful design if failure due to thermal cycling is to be avoided. This is a warning for users that the boasted inert, non-moving quality of the monocrystalline semiconductor device is not absolute. While the germanium rectifier works at so low a temperature that differential thermal expansion between different components is of no significance, with higher-temperature silicon designs, special attention must be given to sustaining the stresses that can result between the many different materials that make up the rectifier sandwich. The discussion also brought warning of a change coming over rectifiers in terms of size. A silicon rectifier can be made impressively small for its rating, a quality that has been exploited by engineers steeped in the practices of the electronics side of the industry, where the rectifier had its birth. Now that power applications are becoming of paramount importance, factors such as tracking distances and clearances are receiving more attention. Larger, but presumably still more reliable, rectifiers should result. This same effect of origin is apparent in the over-wide range of terms used to describe the rating of rectifiers, which vary to an extent that led one speaker to blame them for "confusion, suspicion and distrust" between manufacturer and user. Some of them make provision for safety factors, some stretch capability to the limit. This is something clearly needing early attention and, apparently, receiving it.

UP ON YOUR FEET

The great Michael Faraday was an outstanding lecturer in the exciting days at the Royal Institution when he was laying the foundations of electrical engineering science. Some of his thoughts on the art of lecturing have been collected together by the Royal Institution and published in a slim volume which would make a worthy companion to the "Handbook for Authors," which the IEE thoughtfully makes available to engineers contemplating a public performance. Not all who rise in the new Savoy Place theatre will be able, merely by taking thought, to match the essential demeanour of Faraday's ideal lecturer and "appear easy and collected, undaunted and unconcerned," but much else in his advice lies within their power to accept—and profit by. An "utterance not rapid and hurried ... infusing ideas with clearness and readiness into the minds of the audience" is always welcome; although even with this achieved, Faraday opines with latter-day support, "one hour is enough for anyone." Faraday, in his recorded comments, seems particularly concerned with holding the audience's attention, and sometimes doubtful of it; for, writing of demonstrations that go wrong, he notes with wry wisdom: "I have several times seen the attention of by far the greater part of the audience called to an error by the apology which followed it." This is an endearing hint of an Achille's heel in so mighty a master, one who confessed to an inability to speak or write truly extempore, yet who, his first biographer wrote, "was so natural that the thought of any art in his lecturing never occurred to anyone."

Meteor

This week's quick summary of electrical news faces advertisement page 20

Polythene-insulated power cable development

by A. TOMICA,* B.Sc.(Eng.), A.M.I.E.E.

POLYTHENE as cable dielectric was first used during the second World War in transmission cables, but its good insulating properties and high dielectric strength were soon recognised by the power cables engineer as a possible alternative to impregnated paper. Other dielectric compounds used as an insulant for power cables are polyvinyl chloride and butyl rubber, but Table 1 shows the superiority of polythene from the electrical aspect.

If the high intrinsic dielectric strength of polythene is to be retained in cables, it is necessary to extrude polythene without voids. Further, void formation in service must be prevented, both within the dielectric and at the interfaces of conductor and dielectric, and also dielectric and core screen. If voids are present, ionisation will occur which will weaken the insulation and ultimately cause its breakdown.

Table 1. Properties of synthetic dielectrics

Electrical and Physical Properties	Butyl Rubber	P.V.C.	Polythene
Specific gravity	0·91	1·21	0·92
Moisture resistance	Good	Good	Very Good
Maximum working temperature °C	80	60	70
Specific inductive capacity at 20°C	3·8	5	2·3
Specific inductive capacity at 60°C	3·8	8	2·3
Dielectric power factor at 20°C ..	0·01	0·08	0·0003
Dielectric power factor at 60°C ..	0·02	0·04	0·0005
Long time dielectric strength kV/cm	66	120	170
Maximum operating stress kV/cm	24	26	40
Impulse breakdown stress kVp/cm	300–400	—	400–700

To avoid void formation within the insulating wall of a cable during the application of a plastics insulant, the extrusion has to be carried out under controlled cooling conditions to avoid uneven shrinkage which may result from rapid cooling. Controlled cooling during extrusion, providing a residual-stress-free insulation, will ensure prevention of void formation during service in the dielectric.

To prevent voids forming between the conductor and the insulation, as they may because of mechanical handling or thermal cycling of the cable, a layer of conducting material is applied over the conductor which is designed to make intimate contact with the dielectric under service conditions of the cable. Void formation between the insulation and the core screen of a cable is discouraged by provision of a conducting layer over the dielectric, to perform a function similar to that of the conductor screen.

Although polythene-insulated power cables do not as yet show much economic advantage compared with paper-insulated power cables, their merits have been attracting the attention of those concerned with special cable applications. For example, being non-hygroscopic polythene cables are suitable for submarine use and in damp soil; on account of lightness and non-migratory dielectric, they are suitable as aerial cables and for vertical installations. As Table 1 shows, polythene also has a low dielectric constant, reducing the charging current, low loss factor and low thermal resistance.

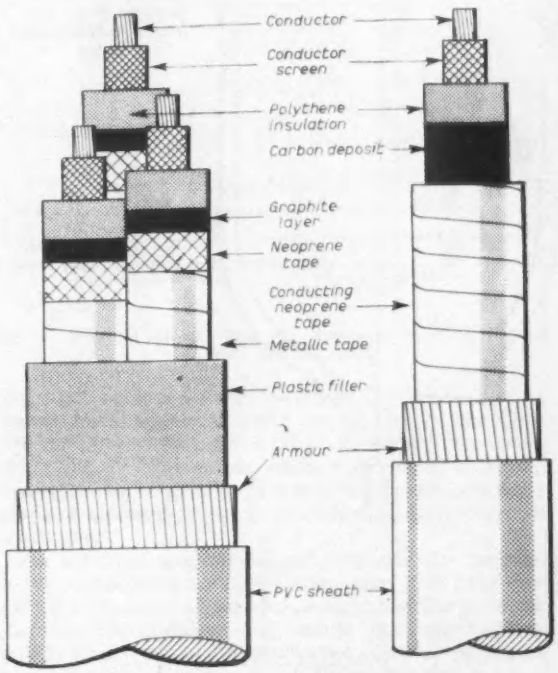


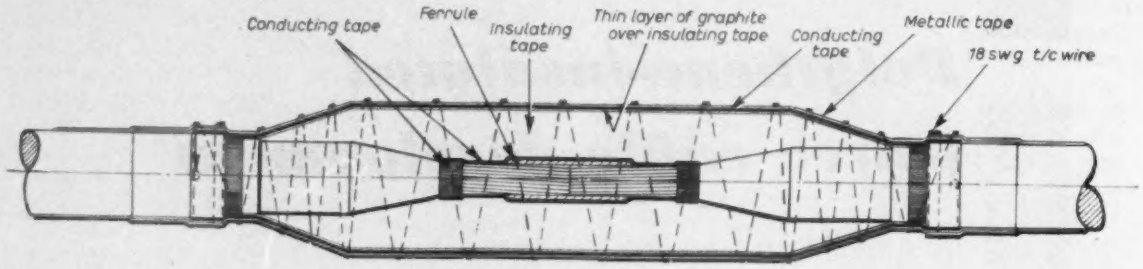
Fig. 1. Cable construction. Left, 11 kV, 3-core polythene-insulated power cable. Right, experimental 44 kV single-core design

The chief attraction in the use of a plastics cable is elimination of the complex structure of a paper-insulated cable, with its associated expensive accessories. Therefore, to date the polythene-insulated power cable has been used mainly in substation cabling, electric traction and similar applications where many short lengths of cable are necessary. Many engineers consider that the simplicity of the polythene cable and its accessories will permit considerable saving in the overall cost of an installation scheme such as a housing estate, where economics are important.

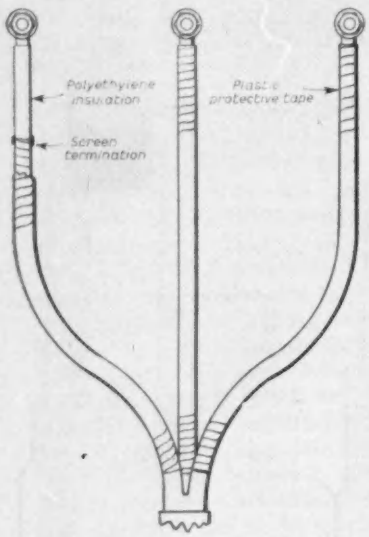
Design of 11 kV Cables

A number of polythene-insulated power cables for 11 kV have been in service since 1953 buried in the ground, installed in air, as submarine and as aerial cables. Fig. 1 shows a typical design of three-core, 11 kV polythene-insulated power cable. It consists of three 0·06 sq in. circular copper-stranded conductors screened with extruded conducting layer of 0·015 in. radial thickness and insulated with 0·10 in. thickness of polythene. The cores

* Mr Tomica, who was formerly with Enfield-Standard Power Cables Ltd., is now with Standard Telephones and Cables Ltd.

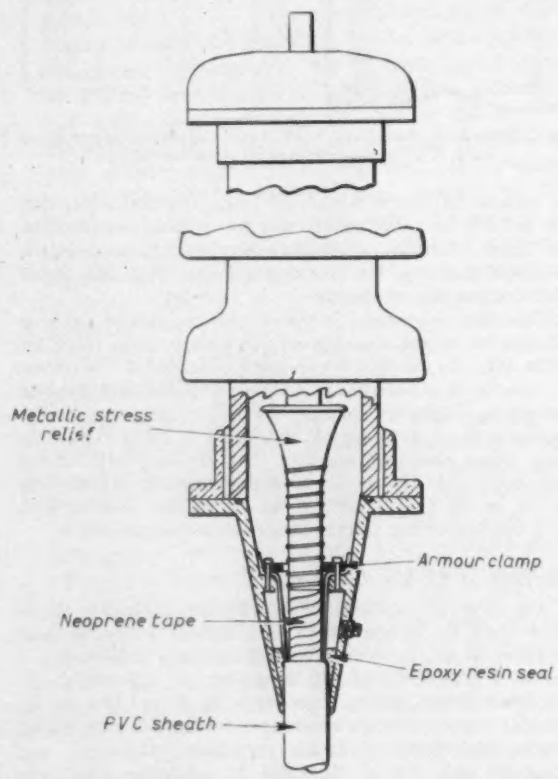


▲ *Fig. 2. Straight joint for 11 kV polythene-insulated power cable*



◀ *Fig. 3. Indoor-type termination for 11 kV polythene-insulated power cable*

Fig. 4. Outdoor-type termination for 44 kV polythene - insulated power cable (only part of the five-shed insulator is shown) ▼



are coated with a thin layer of graphite, followed by conducting neoprene tape backed by copper tape. The interstices of the laid-up cores are filled with plastics material, which also acts as a bedding for the armour. Armouring is sheathed with p.v.c. against corrosion.

Some 11 kV cable designs include carbon paper or carbon-loaded fabric tape as conductor screen and core screen, jute fillers in place of plastics, and jute serving as an overall sheath, with anti-corrosion protection in form of plastics or rubber tapes applied directly over the armour.

In the aerial cable design, the suspension wire is incorporated in an overall p.v.c. sheath, but separated from the main cable sheath by a plastics web.

Joints and Terminations

The most satisfactory solution to the jointing problem would be injection moulding, a method which at present does not readily lend itself to practical application in the field, mainly due to the complex design of the moulding equipment. At present expensive, this method of jointing could not be justified economically for 11 kV cables. Self-adhesive polythene tapes have been used with success, and Fig. 2 shows one core of an 11 kV joint for the cable design shown in Fig. 1.

Continuity of the extruded conductor screen is maintained by applying a layer of conducting tape over the soldered ferrule and exposed strand. The thickness of the added insulation depends on the maximum tolerable electrical stress at the conductor and is taken normally as 50% of the maximum working stress of the cable. The core screen arrangements of the cable (graphite layer-conducting neoprene tape-copper tape) are continued over the added insulation on all three cores, which are then accommodated in a metallic sleeve filled subsequently with a suitable filling compound, e.g., bitumen.

The indoor type terminal for 11 kV cables has the advantage of requiring no special terminating fittings: cores can be directly connected to busbars or to the switchgear without any additional protection, since the surface of the polythene dielectric acts in a similar way to a glazed porcelain insulator. Should the polythene insulation be liable to exposure to direct sunlight, the individual cores must be protected by using a black plastics tape applied over the bare cores, as shown in Fig. 3.

Cables above 11 kV

The basic design of polythene-insulated power cables for higher voltage uses the same principle of screening the conductor and the core insulation as for 11 kV cables. Fig. 1 shows an experimental single-core 44 kV cable with a novel core screen design.

This cable has a 0·3 sq in. stranded-copper conductor with extruded conducting layer over it of 0·020 in. radial thickness followed by 0·37 in. radial thickness of polythene insulation. In place of graphite coating, a continuous layer of carbon is deposited on the cable insulation by

passing the core through a series of adjustable acetylene flames. Rotating brushes between each flame application ensure effective adhesion and surface smoothness of the deposited carbon layer, which is fused with the surface of the dielectric. *(Patent applied for).* Conducting neoprene tapes are then lapped over the carbonised core to a radial thickness of 0·070 in. to combine three functions, viz., as a core screen, as a bedding for the aluminium-alloy armour and to accommodate the expansion of the polythene insulation during temperature raises. Finally, a p.v.c. sheath is extruded over the armour as a protection against corrosion. The overall diameter of such a cable is 2·2 in. This cable was subjected to extensive tests (see Table 2) over a period of three years and remained free of discharge up to twice working voltage.

Table 2.

Test Results for 0·3 sq in. single-core 44 kV Cable.

Maximum stress, 38 kV/cm; Minimum stress, 19 kV/cm.

Continuous Discharge Test

100 yd tested at 1·5 by working voltage (i.e., 37·5 kV): discharge free. Detector sensitivity better than 1 $\mu\mu$C.

Discharge and Bending Tests

Short sample discharge tested at 44 kV: discharge free. After bending six times over 45 in. dia. cylinder: discharge free at 44 kV and 50 kV. Sample put on loading cycle test (20 heat cycles).

Condition of test

Continuously superimposed voltage 37·5 kV, discharge test at 37·5 kV; 6 hr heating with maximum conductor temp. 70°C.: discharge test at 37·5 kV, 18 hr cooling period.

Loading Cycle Test

Outdoor type terminal (see Fig. 4) included after 20 heat cycles. Total No. heat cycles: 170. Conditions of test as above, but power factor/voltage measurements instead of discharge tests. Power factor/voltage stable throughout the test, 0·0001 at room temperature. 0·00007 at 70°C.

Discharge Test on Cable from Loading Cycle Test

7 yd of cable from loading cycle test cut out after 50 heat cycles, and discharge tested at 37·5 kV: discharge free.

Impulse Test

Two samples tested at maximum conductor temp. 70°C, one including an outdoor type terminal.

Sample No.	*Withstand Voltage*	*Withstand Stress*	*Breakdown Voltage*	*Breakdown Stress*
1.	340 kVp	515 kVp/cm	358 kVp	545 kVp/cm
2.	346 kVp	525 kVp/cm	357 kVp	542 kVp/cm

The cable showed no signs of instability during the loading cycle test and the impulse breakdown values obtained are in good agreement with published data on impulse strength of polythene. They provide a sufficient margin over the required withstand voltage, 243 kVp for 44 kV cables.

Joint and Terminations for 44 kV Cable

The outdoor type terminal shown in Fig. 4 passed successfully the hot impulse test and showed no signs of instability on a loading cycle test which consisted of 150 heat cycles. Two interesting features are incorporated in the termination design: the use of epoxy resin and polyisobutylene as the insulating filling compound. The terminal is housed in a porcelain sealing end; the armour is fixed to the gland by the epoxy resin, which also acts as a seal for the filling compound.

Testing of Polythene-insulated Power Cables

At present, no tests have been standardised for plastics-insulated cables. Consequently, the tests carried out on the 44 kV polythene cable (except the discharge test)

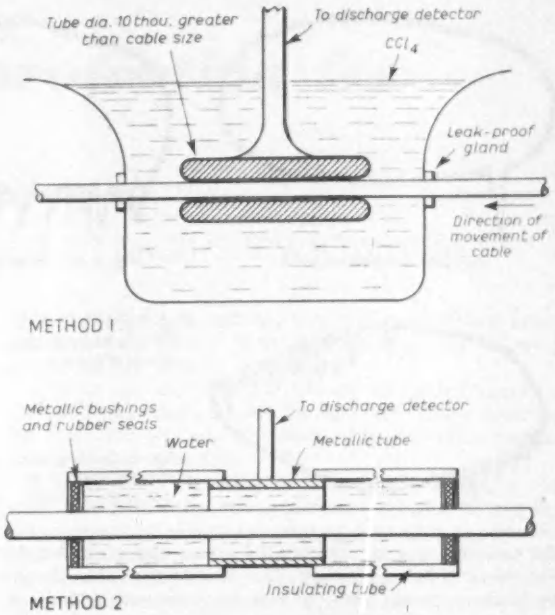


Fig. 5. Electrode arrangements for continuous discharge test on polythene-insulated cables

described in this paper were formulated on the basis of the type approval test specification agreed upon by the Cable Makers' Association, the Central Electricity Generating Board and the area boards. There is no reason to suppose that when an appropriate test specification for polythene-insulated cables is issued it will differ basically from the above tests.

The electrical and mechanical tests that are included in this specification are well known, since they have been applied to paper-insulated h.v. power cables for a number of years. The discharge test, and in particular the continuous discharge test on unscreened cores of polythene-insulated cables, is still in the development stage and it is hoped that standardisation will be possible in the near future.

Discharge Tests

It was stated in the introduction to this article that satisfactory performance of polythene-insulated cable can be achieved only if the cable is free from voids during manufacture and during subsequent mechanical handling and thermal cycling which the cable must withstand in service. To prove the absence of voids after manufacture, every length of unscreened core is passed through an assembly of electrodes and subjected to continuous discharge test.

The electrode assembly for the continuous discharge test can assume different forms, but probably only two arrangements deserve a detailed description, since the other forms differ only in details, not in principle.

In the first arrangement, the core is passed continuously through a smooth cylindrical metal tube, properly shaped at its ends to relieve high electrical stress concentration which may interfere with, or even mask, discharges occurring in the cable. The tube is immersed in a suitable dielectric liquid contained in a tank of either insulating material or metal, the latter appears to give better results for high-voltage cables if suitably formed to avoid high stress concentration (Fig. 5). The high-voltage supply is connected to the search electrode, which is insulated from

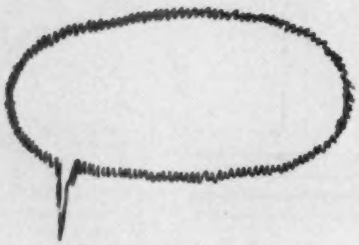


Fig. 6(a). Calibration pulse

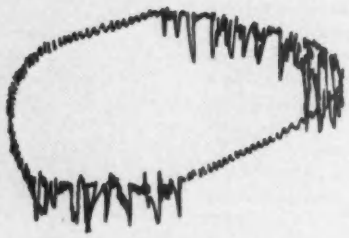


Fig. 6(b). Discharge in the insulation

Fig. 6(c). Discharge at conductor screen

Fig. 6(d). Discharge at core screen of cable

Fig. 6. Oscillograms showing position of discharges in cable

the tank by spacers, which also act as clamps and hold the tube rigidly in position. The core of the cable should be in close contact with the searching electrode, otherwise correction to the applied voltage would be necessary, taking into account the geometrical dimensions of the arrangement and the permittivities of the core insulation and the testing medium. It is desirable to avoid the need for voltage correction as it is difficult to achieve concentricity of the cable inside the tube. The conductor of the cable and the metallic tank are earthed during the test.

Any discharges occurring either in the insulating wall or at its boundary with the conductor screen are displayed on the screen of a cathode ray tube, forming part of the discharge-testing arrangement known as "discharge detector." The magnitude of the discharge is determined by knowing the values of the parameters of the detector and the calibrating pulse which is injected into the circuit and also displayed on the screen. Detailed descriptions of the discharge detector have been published and it is sufficient to mention that by the position of the discharge displayed on the screen of the detector the voids in the cable can be located (Fig. 6).

The discharge responses are in the form of vertical pulses superimposed on the elliptical trace. The response in Fig. 6(a) is due to noise in the detector and the single discharge included is the calibrating pulse. The responses shown in Fig. 6(b) represent internal discharges in voids within the insulating wall. The responses are equal in number and magnitude on both half cycles.

If discharge takes place at the interface between the conductor screen and the insulation, the response shown in Fig. 6(d) will be obtained, discharge pulses being unequal in number and magnitude, the larger ones occurring on the positive half cycle. Similar response to that in Fig. 6(c) but with the larger pulses in the negative half cycle is shown in Fig. 6(d) when discharge occurs at the surface of the dielectric.

In the second method of detecting and locating voids in the cable, the core is passed through a pipe filled with water and made of insulating material incorporating a short metallic tube in the centre and metallic bushings at the ends fitted with rubber seals. The high voltage supply and the discharge detector are connected to the metallic tube. The cable conductor and the metallic bushings are connected to earth (Fig. 5).

The applied voltage has its maximum at the centre of the short metallic tube and minimum at the metallic bushings. In this way, the problem of stress concentration at the edges is eliminated. Discharges in the cable are determined in the same way as in the first method.

On considering the merits of the two methods of continuous discharge-testing of plastics cables, the second one is seen to be simpler and more attractive. The electrode arrangement in the first method is elaborate and expensive, different size of tubes for the search electrode being required for different size of core; the simple metallic tube in the second method will accommodate any size of core. A dielectric liquid of high electric strength and free of discharges at the testing voltage is required in the first method; in the second arrangement, water is used as the testing medium. Conductivity of the water, however, has to be kept at a fairly low level in order not to overload the testing transformer.

Conclusions

There has always been a desire to provide a dielectric for a high-voltage cable which can easily be applied to the conductor and so enabling the paper-insulated cable to be superseded. It is not going to be easy to supplant the paper-insulated cable which has given such an excellent record for many years. However, polythene seems to be the best alternative, and the limited application of cables for 11 kV and above have indicated a useful future for this insulation. When extrusion techniques have been improved, testing procedures standardised, jointing techniques simplified, the polythene cable could be a serious rival to the mass impregnated paper-insulated cable for 33 kV and even higher voltages, provided economic considerations are favourable and regulations clarified.

Acknowledgments are due to Enfield-Standard Power Cables Ltd. for permission to publish the article.

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Power-arc protection for insulators

VALUE OF MODIFIED ARCING FITTINGS SHOWN BY TESTS

INSULATORS can be protected almost completely against damage caused by power-arcs if ample distance is allowed between the arcing horn gap and the insulator sheds and if deflector rings are fitted. These conclusions emerged from an investigation carried out at Queen Mary College into the behaviour of power-arcs on insulators, both in still air and under conditions of high wind velocity. The investigations were outlined to a meeting of the IEE last week by Dr A. E. Guile.*

While the findings may usefully be applied to future designs of insulator protection devices, Dr Guile points out in his paper that faults in this country due to insulator damage are so low—up to 66 kV only 1·5 per route mile per year—that modification of the 1½ million or so insulators in service would hardly be economically justifiable. However, for insulators in special positions, for example, on switchgear or transformers, the fault rate is higher. Faults are also greater on 132 kV systems, at 1·7 per route mile per year, and on these systems the ratio of faults caused by atmospheric pollution to those caused by lightning was also higher than lower voltage systems.

Statistics from overseas suggest that the rate of insulator damage due to power-arcs is higher than in this country, and that there is a strong case for using the fittings described in the paper to give better protection.

Power-arcs

A power-arc between the line and earthed portions of an insulator may follow flashover caused either by lightning or surface breakdown as a result of atmospheric pollution. Arc currents varying from quite low values to as high as 12 kA may be experienced in practice. The test equipment available was only able to give arc currents up to 1,400 A, and all the tests were made with arc durations of 1 sec, which was a fair compromise with the supply system clearance times of between 0·2 sec and 2 sec. The arcs were initiated by fine fuse wire stretched between metal parts. The author was able to show that this method gave reliable accordance with experience. By using wind tunnels, it was possible to test both 11 kV and 33 kV insulators in still air and subject to wind speeds up to 60 m.p.h.

Results of Tests

Dr Guile described tests on both 11 kV and 33 kV bushings of the type used on transformers and switchgear. Bushings with a double pair of arcing horns, as currently used in Great Britain, were tested, and also with a single pair of arcing horns which, although superseded in this country, are widespread overseas. The double pair of arcing horns has a bracket mounted on the bushing between a pair of bushing sheds. The upper and lower arcing horns are on opposite sides of the bushing. As a result of 250 tests, with flashover initiated both across the arcing horns and across the surface of the bushing sheds, the following conditions for damage were found.

1. With the arc initiated between the arcing horns, if the wind was strong enough to blow the column back on the sheds but was not sufficiently strong to drive the arc root from the horn tips.

2. After either lightning or a surface flashover, if the wind was sufficiently strong to cause the arc to transfer to the downwind side of the bushing, then damage occurred on the single gap arcing horns if the arc was between the top flange and either the bushing flange or a projection on it. For the twin gap arcing horns, damage occurred when the arc was between the bottom flange and the central collar support for the arcing horns.

3. In still air, damage occurred after a surface flashover if the arc failed to move out on to the arcing horns but instead remained between the bushing cap and base.

Condition 1 could be avoided by increasing the distance of horns from the sheds as shown in the table. Conditions 2 and 3 could be prevented by fitting deflector rings at the top and bottom of the bushings and designed with a gap, positioned to lead the arc onto the arcing horns as it travelled round the ring under the influence of wind and magnetic forces. For bushings protected by a

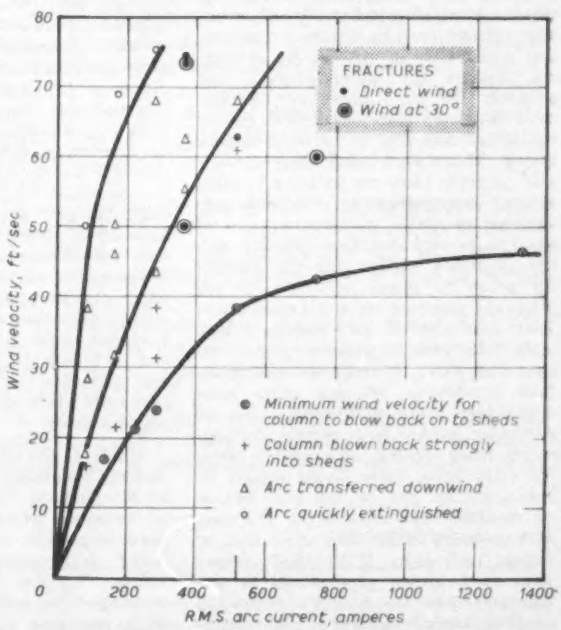


Fig. 1. Stages of arc position with wind velocity for 11 kV bushings. The lines show well-defined regions where, (a) the arc is on the horn tips but the column is clear of the sheds, (b), as (a) but column blown back on sheds, (c), wind transfers arc to downwind side of bushing, (d), arc quickly extinguished. This only occurs at low currents and high wind speeds

* Paper 3289: "The Protection of High Voltage Insulators from Power-arc Damage," by A. E. Guile, PH.D., B.SC.(ENG.), A.M.I.E.E. Dr Guile is in the electrical engineering department, Queen Mary College.

single pair of horns, it was also found necessary to add a second set of horns opposite the original ones. For bushings with two pairs of arcing horns in series, adding a third deflector ring to the centre collar was satisfactory.

The arcing fittings should be designed to allow only a single direction of current flow, towards the arc roots, to give a driving force which will ensure that the arc travels round the protective deflector rings quickly to a place where it cannot cause damage. The tests showed that this travel time is little affected by the materials used for the arcing fittings. Other tests also showed that the rate of burn-away of tinned brass horns was about twice that for mild steel, indicating that a return to galvanised steel arcing horns might be advantageous.

The paper also described tests made on pin, post and suspension insulators. For the porcelain pin insulator shown in Fig. 2a, with arcing horns formed according to BS 1320, arcing damage was caused by the horn directing the arc onto the bottom shed. This was easily overcome by the modified horn shape shown in Fig. 2b. An arc across the insulator surface at right-angles to the wire also caused the bottom shed to shatter. This could be overcome by additional wire arcing horns at right-angles to the conductor wire, but, for complete protection, wire projections would also have to be added to the pin itself. This would also overcome damage which occurred even in still air due to the arc root remaining high up on the pin, under the bottom shed.

Toughened glass pin insulators were found to fracture at a wind speed of 20 m.p.h. or more, when the arc remained on the downwind side of the insulator surface,

Min. safe distance of horns from sheds for bushings

Gap spacing in.	Min. distance in.
1½	2½
2	3½
3	4½
4	4½
5	4½

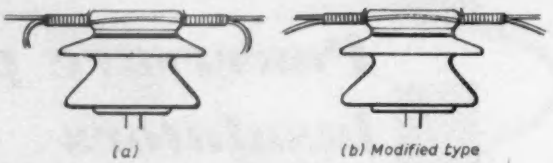


Fig. 2. Modification to pin insulator prevents damage to bottom shed (a) arcing horn to BS 1320; (b) modified arcing horn

DISCUSSION

MR N. G. SIMPSON (BICC), complimenting the author on his paper, said he felt it badly needed a companion paper dealing with the supply industry's experience. National statistics concerning damage to insulators could be very misleading unless account was taken of regional influences and other factors. Overseas records of insulator failures due to power-arc damage were particularly sparse. Increasing reliability of overhead systems must be a prime consideration particularly in view of the increasing pressure for undergrounding and probably the most important development since the war was growth in the use of the unearthed or partially earthed system. These were being adopted overseas, in some cases up to 132 kV. Such systems were confined to wood pole construction to enable the impulse value of wood to be exploited. One difficulty with the unearthed system was the liability for phase to phase punctures of pin insulators mounted on metal cross arms. There was also on such systems a lack of balance between phase to phase voltages and phase to earth voltages under fault conditions. Wooden cross arms might give better performance, but of particular interest were current developments using plastics or moulded resins for cross arms. Tests would shortly be conducted by one of the area boards on moulded resin cross arms. The snag with moulded resin cross arms was, of course, their price. If insulated systems were used, arcing gaps would be unnecessary, but the author's techniques could be usefully applied to end connections. Another application of increasing importance was to avert power-arcs on railway overhead system insulators caused by pantograph flashovers. Returning to the fallibility of statistics, he said that although the author had shown damage due to power-arcs was relatively rare, he had overlooked the fact that protective fittings were ridiculously cheap even if they gave protection against only one fault in a year.

MR D. F. OAKESHOTT (CERL) said that 132 kV transformer bushings in general had increased clearances to prevent arc damage and protection systems ensured a short arc duration. The author's suggestions for elimination of projections on clamping fittings and provision of U-pieces were perfectly feasible and even more so were his suggestions for modifying arcing horns. But he doubted if deflector rings would be practical in this country. They would reduce phase to phase clearances and might increase damage caused by birds and debris. Tests had also shown that they considerably modified the impulse characteristic of bushings. The author's paper also drew attention to the way in which, for example, 33 kV switchgear bushings could be modified to reduce risk of arcing damage. Arcing horns on the underside of the bushing could obviously cause damage to the bushing and test sheds.

MR D. J. MILLER (Preece, Cardew and Rider) commented that he was alarmed at Mr Simpson's references to a return to unearthed systems. It seemed a retrograde step which might result in damage under fault conditions by capacitive voltage transfer between transformer windings. The author's tests had shown that, providing clearance between the copper top cap of a pin insulator and the top shed was ensured by ¼ in. or so of cement, damage was virtually eliminated. This seemed a simple and worth-while modification.

MR R. N. BUTTREY (South Wales Switchgear) agreed with Mr Oakeshott's comments on damage to circuit-breaker bushings by flashover and said this was a good reason for developing arcing horns to eliminate such damage.

MR L. GOSLAND (ERA) said it was a pleasure to find an IEE paper recording research at a practical level in a university. He thought such research very useful and it was a pity it was not pursued more widely.

MR F. C. WALMSLEY (Micanite and Insulators) asked if the findings would be affected by current fed into the fault through a transformer secondary instead of from the line.

In reply, Dr Guile said he could vouch for Mr Simpson's distrust of statistics. He believed, for example, that in one area board all the failures recorded for the year had actually occurred in one night. Insulator failures on unearthed systems were likely to be one-half to one-third of those on earthed systems, although some overseas countries put the figure as low as one-quarter. He agreed with Dr Oakeshott that on e.h.v. systems, arcing time would normally be short provided there was no bus protection failure. If failure occurred then the resultant damage was worthy of consideration. He agreed that the use of deflector rings on switchgear bushings might increase the possibility of interphase flashover. It might not be necessary, however, to take the rings completely round the bushing. Although as had been said, deflector rings could if poorly designed increase the likelihood of flashover between phases, or due to vermin and also change the impulse characteristic of a bushing, it seemed to him that they were a necessary part of a system.

causing the top shed to break. This type of failure was not found, however, on one design which had the copper top cap spaced from the toughened glass top shed by about ½ in. of cement filler.

The pedestal insulators tested were less prone to damage than the pin insulators, although an 11 kV post insulator sustained damage to a bottom shed at a wind velocity of only 13 m.p.h., directed at right-angles to the conductor. Some conductor burning was also evidenced on a 33 kV bushing but in no case was the damage sufficient to affect operation of the bushing.

Tests on a three-unit string suspension insulator showed that damage could occur in still air as a result of lightning flashover, although it was more likely to occur in a wind. Double-pointed arcing horns, parallel to the conductor, did not give complete protection for a wind at right-angles to the conductor, as the wind could still cause the arc to root on a pin. Although these double-point arcing horns protected the conductor, a deflector ring was also necessary to prevent damage to the bottom insulator in the string.

Arc Duration Effects

The effect of arc current on the ability of a toughened glass insulator to withstand fracture was tested for different times of arc application. Although, below currents of about 400 A, fracture time might vary from 1 sec to several sec, at currents in excess of 1,000 A there was little reduction in fracture time below ½ sec. The time to fracture was also little affected by whether the insulator was near the arc root or a few inches away from it, indicating that damage could be equally severe by either the arc root or column although, because the root remained relatively stationary, damage on the test insulators occurred more often near the arc root.

The way in which an arc moved when subjected to wind was determined by examining an arc struck between horizontal parallel electrodes in a wind tunnel. When current was fed to one end of the electrodes, the arc moved away from this end under the influence of magnetic forces. The arc became stationary when the wind velocity was equal and in opposition to the arc velocity for the electrode spacings varying from 1½ in. to 7½ in. and a.c. up to 3 kA used in the tests, although an increase in the electrode spacing or current required less wind velocity than the still air arc movement velocity. The governing factor in arc movement was the movement of the cathode root and this in turn depended on the surface of the electrodes. On a roughened surface the velocity of the cathode root might be 12 times that on a smooth surface. The authors concluded that the cathode surface played a vital part in arc movement and that to regard the arc as a physical conductor in a magnetic field was quite fallacious.

Readers Views

Correspondents writing under pseudonyms are asked to submit their names and addresses in confidence to the Editor

Is this a Record?

TWENTY-FIVE years ago we supplied an electrical trawl winch for the French trawler *Mercedita*. The vessel has now passed into Greek hands and the new owners have asked for a wiring diagram.

Ordinarily, this would not surprise us, but we are informed that the vessel was sunk three times during the war. The letter adds: "The equipment is all in very good condition."

We are used to making marine electrical equipment that outlasts the ship, but after three sinkings we really think we might expect an opportunity to quote for replacements! All we get out of this performance is a request for a wiring diagram (with which we shall send a copy of "Instructions for Drying-out Electrical Equipment," for possible future use!).

T. J. Barfield,
PUBLICITY MANAGER,
LAURENCE, SCOTT AND ELECTROMOTORS LTD.

Salaries in Jamaica

I HAVE recently returned to the United Kingdom from Jamaica, and I am concerned to note that posts in that country are being advertised at salaries which are too low to give a qualified engineer a fair return for the work which he will have to undertake.

There are a number of things which tend to mislead an appointee, such as figures published by the Royal Commonwealth Society, the level of surtax and published salaries of Government officials. All these create a picture of a cost of living only slightly higher than that in the United Kingdom. Unfortunately, the true position is that it is roughly twice as high and is rising steeply.

I have prepared a budget for a family of four which shows that a gross income of £4,800 per annum is necessary to live comfortably and this includes only the minimum of entertainment for close friends. Two of the basic items are rent, which would amount to £720 per annum for a comfortable house in the Kingston area, and food and other related items, such as cleaning materials for the house, which would cost £728 per annum. Servants, education, saving towards leave spent in the United Kingdom, subscriptions, medical treatment (which can easily amount to £5 for a single visit to a doctor), car expenses and miscellaneous spending bring the net figure to over £3,000.

Taxation is heavier than in the United Kingdom as there is no earned income relief and interest payments on mortgages or overdrafts do not qualify for treatment as expenses. To earn £3,000 net the income must be of the order stated.

A satisfactory arrangement would be a salary of £2,500, with house, car and medical benefits provided by the company, and an initial outfit allowance of £100 paid on appointment.

Should any reader contemplate accepting a post in Jamaica I would willingly answer any questions or supply the addresses of independent persons who would advise him.

J. P. Weston.
BIRMINGHAM 17.

Advice to a Lecturer. Under this title, the Royal Institution has collected together many of the opinions on lecturing expressed by Michael Faraday in letters to a friend. Some extracts from these are the subject of editorial comment on page 200. Copies of the booklet are obtainable from the Secretary, Royal Institution, 21 Albemarle St, W.1, at a cost of 2s 6d, inclusive of postage.

D.C. field windings and coils

NOTES FOR NATIONAL CERTIFICATE TEACHERS

by J. E. Macfarlane,* B.Sc.(Eng.), M.I.E.E., A.M.I.Mech.E.

EVEN though the time devoted to electrical machines in the Ordinary National Certificate courses is to be reduced to allow a broadening of the syllabus, some of the following material may prove useful to part-time teachers and also others who are dealing with more advanced work. Calculations on the ampere-turns or m.m.f. required for a magnetic circuit are only of academic interest if the method of providing the necessary excitation is not explained. In a former article[1] the author dealt with simple d.c. armature windings, and these notes explain the arrangement and calculations of the electrical circuit part of the field system.

Two main considerations are involved in the design of a field winding:

(i) it must provide the required *m.m.f.* or *ampere-turns per pole*; and

(ii) the *heating* must not exceed a safe limit for the type of coil considered and the insulating material employed.

The net heating is proportional to the I^2R loss and inversely proportional to the cooling surface. With field coils, the outside curved surface of the winding dissipates most of the heat compared with the coil ends, and a steady temperature is reached when the heat generated equals the heat dissipated, which is generally given in watts per unit area. A simple example will illustrate this point.

Example 1. A relay coil is connected to a 50 V supply and has 2,600 turns with a resistance of 250 ohms. Calculate the ampere-turns provided and the watts loss in the coil.

If the length and external diameter of this relay coil are to be the same and the watts dissipated are limited to 0·8 watts/sq in. of curved surface, find the minimum external diameter.

Current $=50/250=0{\cdot}2$ A. $\therefore$ m.m.f. $=0{\cdot}2\times2600=520$ amp-turns and watts loss $=0{\cdot}2^2\times250$ or $50\times0{\cdot}2=10$ watts. Let the external diameter and length of the coil be x inches, then the area of the curved surface $=\pi x^2$ in.^{2}, and $0{\cdot}8\times\pi x^2=10$ W, hence $x^2=3{\cdot}99$ so the length and diameter are 2 inches.

For circular coils on an iron core the most economical external diameter is three times the core diameter, with length and external diameter approximately the same.

The *shunt field coils* of d.c. machines are usually connected in series, with the machine voltage applied to the shunt field circuit which may include a shunt field rheostat. In the case of generators about 85% of the rated voltage is considered to be applied to the shunt field coils leaving some margin in the rheostat, but with d.c. motors a more accurate value of AT/pole is required when a shunt field regulator is not employed. The *series* and *interpole* coils are connected in series with the armature and carry the load current, but with large currents a series-parallel or even a parallel arrangement of the coils may be necessary to obtain the requisite AT/pole and a reasonable size of conductor, and in some cases a diverter is fitted.

The series winding may be wound on top of the shunt coils in small machines and consist of round or rectangular wire suitably insulated. On large machines strip copper is used, often wound "on edge" and located at the front of the pole on the pole horns. For example a 460 V 175 kW, 450 r.p.m. compound wound generator had eight shunt field coils each of 1,000 turns to give 4,500 AT/pole, so the shunt field current was 4·5 A. The series winding of strip copper consisted of five turns per pole, which at the full load current of 380 A gives 1,900 AT/pole. Thus the field coils have to provide a certain number of AT/pole and generally the space available or the weight of copper that can be accommodated is known together with the length-mean-turn of the respective coils and their radiating surfaces.

Length-Mean-Turn and Resistance

Circular Coil Bobbin. The dimensions of a circular coil bobbin are shown in Fig. 1, in which

D_0 = outside diameter

D_1 = inside diameter

l = axial length

b = winding depth $=\frac{1}{2}(D_0-D_1)$

The outside perimeter is πD_0.

The Length-Mean-Turn (LMT) $=\pi(D_1+b)$ or $\frac{1}{2}\pi(D_1+D_0)$. The cross-sectional area of the winding space is bl and consists of a mixture of conductor metal and insulation. If there are n turns of wire each with a bare c.s.a. of "a" then the space-factor of the coil is

$$\frac{\text{Sectional area of conductors}}{\text{Sectional area of winding space}}=\frac{na}{bl}=K$$

The space-factor (K) depends upon the amount of insulation on the conductors and the method of winding, being high for rectangular conductors which have least space between copper and low for the larger sizes of round wire which may not bed very well together. The actual figure depends upon the practical conditions.

Working from first principles, take the insulated diameter of the wire as d_1. Then the number of layers $=b/d_1$ and turns per layer $=l/d_1$ so the number of turns $(n)=bl/d_1^2$, neglecting the effect of bedding and spreading as the coil is wound. With the larger round wires in an even number of layers, two layers when bedded have a depth of $1{\cdot}866d_1$, as shown in Fig. 2, compared with $2d_1$ if the wires are on top of one another, and one turn must be allowed on the axial length for the spiralling effect. These refinements are not often necessary as the number of turns per square inch of coil c.s.a. is generally known for the different sizes of wire and types of insulation.

Rectangular Coil Bobbin. The laminated poles of machines of rectangular shape may be provided with a metal bobbin or a composite arrangement of insulating material. Let the winding dimensions of the pole core be x and y over the insulation and the winding depth is b as shown in Fig. 3.

*Mr Macfarlane was until recently head of the electrical engineering department, Liverpool College of Technology.

Then the LMT=2 (x+y)+πb and the outside curved perimeter is 2 (x+y)+2πb or LMT+πb. With n turns per coil the total length of wire per pole is n×LMT.

Conductor Area

If the resistivity of the conductor material is ρ and its area is a, then the resistance per coil is

$$R_c=\rho\times n\times LMT\times a^{-1} \text{ ohms.}$$

With an applied voltage of V_c volts/coil the current is V_c/R_c and the m.m.f. per coil is

$$n(V_c/R_c) \text{ AT/pole}=\frac{nV_c a}{\rho n.LMT}$$

hence the cross-sectional area required for the wire is

$$a=(\rho\times LMT\times AT/pole)/V_c$$

and the bare diameter of the wire $d=\sqrt{(4a/\pi)}$.

Note that the axial length of the coil "l" does not enter into this calculation, as the conductor area is proportional to the required m.m.f. and inversely proportional to the excitation voltage for a given LMT and conductor material. But the axial length must be brought in when heat dissipation is considered as increasing the number of turns reduces the current and with it the heating to some desired value but increases the weight of copper.

Example 2. A coil of a d.c. contactor is wound with 20 s.w.g. having a diameter of 0·036 in. It is required to rewind the coil for use on 500 V compared with 400 V originally. If the duty is the same what size of wire should be used?

As "a" is inversely proportional to V_c, d is proportional to the square root of V_c^{-1}.

Hence $d=\sqrt{(400/500)}\times 0{\cdot}036=0{\cdot}0322$ in. and the nearest size is 21 s.w.g. with a diameter of 0·032 in.

Example 3. Describe the construction of a shunt field coil of a d.c. machine. Explain what precautions are necessary when bringing out the individual coil-ends for connecting up. A magnet coil has internal and external diameters of 16 cm and 20 cm, respectively, and an axial length of 6 cm. When 60 V is applied to this coil the power taken is 90 watts and 2,700 ampere-turns are provided. Calculate the diameter of copper wire required and state which size of wire would be used from the table below. Estimate the space-factor of the coil, assuming the resistivity of copper at the working temperature is 2 micro-ohm-cm.

Gauge ..	20 s.w.g.	21 s.w.g.	22 s.w.g.	23 s.w.g.	(S3-O.N.C.)
Diam. mm.	0·90	0·813	0·711	0·610	

$$LMT=\tfrac{1}{2}\pi\ (16+20)=56{\cdot}6 \text{ cm.}$$

Current=90/60=1·5 A. Resistance of coil=60/1·5=40 ohm.

Number of turns/coil=2,700/1·5=1,800.

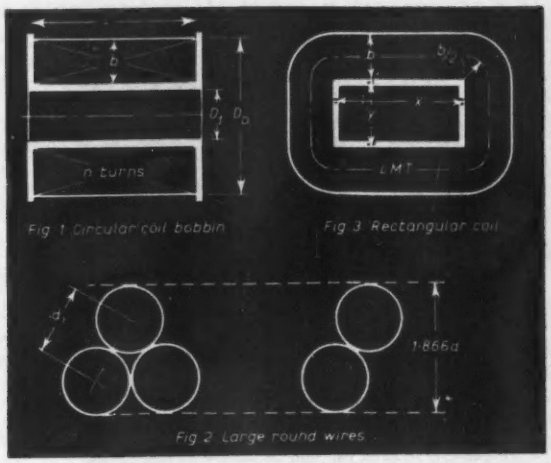
$$\text{From } R=\rho l/a,\ a=\frac{2\times(1800\times 56{\cdot}6)}{10^6\times 40}$$

$$\therefore d=\sqrt{\frac{0{\cdot}005094}{0{\cdot}7854}}=0{\cdot}0804 \text{ cm}=0{\cdot}804 \text{ mm.}$$

Hence 21 s.w.g. would be used with a diameter of 0·813 mm. and c.s.a. of $\pi/4\ 0{\cdot}813^2=0{\cdot}52$ mm²=0·0052 cm². The winding depth is ½(20−16)=2 cm and axial length 6 cm, hence the

$$\textit{space factor}=\frac{1800\times 0{\cdot}0052}{2\times 6}=0{\cdot}78, \textit{ or } 78\%.$$

Example 4. The following particulars refer to the shunt field coil for a 500 V, 6-pole, d.c. generator: AT/pole=7350, depth of winding 2 in., length of inside turn 43 in., length of outer turn 55 in., watts radiated per sq in. of outside surface, excluding the ends, 0·9 W; space factor 65%, resistivity of hot copper wire 0·8 μΩ-in. Calculate (a) the diameter of the wire, (b) the axial length of the coil, (c) the number of turns and (d) the exciting current when the p.d. across the coil is 85% of the full voltage. (A1—H.N.C.)



Figs. 1 to 3. Basis of Length-Mean-Turn and resistance calculations described in text

$$LMT=\tfrac{1}{2}(43+55)=49 \text{ in.}$$

Exciting voltage=0·85×500=425 V.

$$\text{Now } a=\frac{\rho\times AT/pole\times No.\ of\ poles\times LMT}{\text{Exciting voltage}}$$

$$=\frac{0{\cdot}8\times 7350\times 6\times 49}{10^6\times 425}=0{\cdot}00407 \text{ sq in.}$$

$$\therefore d=\sqrt{\frac{0{\cdot}00407}{0{\cdot}7854}}=0{\cdot}072 \textit{ in } (15 \text{ s.w.g.}) \text{ (a)}$$

If "l" is the axial length and the curved perimeter of the coil is 55 in., then watts loss/coil=55 l×0·9=49·5 l.

The volts/coil is 425/6=70·8, so the current is (49·5 l)/70·8=0·7 l A. As the coil depth is 2 in., coil copper area=0·65×2 l in.² so Turns/pole=0·65×21/0·00407=3201.

Hence 0·7 l×320 l=7350 AT/pole.

$\therefore$ l=$\sqrt{32{\cdot}8}=5{\cdot}73$ in., say, $5\frac{3}{4}$ *in.*

(b) Turns/pole=320×5·73=*1,835* (c) and

Exciting current=0·7×5·73=*4·01 A* (d).

Calculation from Weight of Coil

Instead of the space for a coil being specified the weight of the wire may be given instead. If this includes the insulation on the wire a percentage should be deducted for the covering, as shown in the table below for d.c.c. insulation, or an allowance made on diameter.

Gauge, s.w.g.	14	16	18	20	22	24	25	26	28	29	30
Percentage allowance	4	5	6	7	8	10	12	13	15	16	17
Allowance on diameter		6-12 s.w.g. 0·012 in. 18-20 s.w.g. 0·008 in.					13-17 s.w.g. 0·010 in. 21-28 s.w.g. 0·006 in.				

Thus 20 s.w.g. has a diameter of 0·036 in. and the total thickness of insulation is 0·0025 in. for enamel, 0·006 in. for single-cotton-covering and 0·007 in. for double-cotton-covering. It is sometimes necessary to use two consecutive gauges of wire for a coil to obtain the required m.m.f. The larger wire is wound adjacent to the pole core and the smaller wire on the outside of the coil. When the winding space is known, a method of calculation is given

by L. Greenwood.[2] A method of calculating the watts loss from the weight and current-density is sometimes useful for any type of winding whether on a field or armature, as the following example shows.

Example 5. Show that the watts loss in a given length of wire carrying a certain current is given by K (current density)^2 × weight. Determine the value of K for copper wire with a resistivity of 0·8 $\mu\Omega$-in. and weighing 0·32 lb/cu in. A shunt field coil consists of 9 lb of 22 s.w.g. and 5 lb of 23 s.w.g. Calculate the watts loss when carrying 0·7 A.

Size of wire	22 s.w.g.	23 s.w.g.	
c.s.a. in.^{2}	0·00062	0·00045	(S3—O.N.C.)

Weight (w) = dla, where "d" = weight per unit volume, "l" = length and "a" = c.s.a., hence l = w/da. Now $I^2R = I^2\rho l/a = \rho/d\ I^2/a^2$ W, thus the constant $K = \rho/d$ as I^2/a^2 is the current density squared. For inch dimensions and lb weight.

$$K = 0{\cdot}8/10^6 \times 0{\cdot}32 = 2{\cdot}5 \times 10^{-6}.$$

Now with 0·7 A, on 22 s.w.g. the current density is 0·7/0·00062 = 1,130 A/in.^{2} and on 23 s.w.g. 1,555 A/in.^{2}

Hence the watts loss $= 2{\cdot}5 \times 10^{-6}\{(1130^2 \times 9) + (1555^2 \times 5)\}$
$= 28{\cdot}8 + 30{\cdot}3 = 59{\cdot}1$ *watts.*

Interpole Coils

In a 1,600 kW, 480 V, 3,340 A, 10-pole d.c. generator the strip-on-edge coils and connections for each interpole have a weight of 37 lb and the current density is 1,990 A/in.^{2} Using the formula already developed, the watts loss per pole is $2{\cdot}5 \times 10^{-6}(1{,}990)^2 \times 37 = 368$ watts, hot. When cold, the loss is given by 368/1·2 = 307 watts. As the interpoles are arranged in two parallel circuits the resistance per pole is

$$\frac{307}{1{,}670^2} = 0{\cdot}00011 \text{ ohm}$$

which is in good agreement with the value of 0·000116 ohm cold, calculated from the dimensions of the winding.

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2. Greenwood, L.: "Design of Direct Current Machines" (book), Macdonald, p. 115.

Buenos Aires Supply Insight

BIG schemes backed by little money or experience sums up the impressions of electricity supply in Buenos Aires, retailed by Mr L. H. Welch, O.B.E., B.SC., A.M.I.E.E., Chief Engineer of the LEB, when he gave the open meeting address to the Chief Technical Assistants' Association last week. Mr Welch visited the Argentine recently as a member of a team studying the supply situation in the capital before making recommendations to the World Bank.

The supply industry, he said, was hampered by extreme examples of restrictive practices backed by the single electrical trades union, by chronic lack of money and by engineers who, although well trained theoretically, were given responsible jobs before being able to acquire practical knowledge. The city of 5½ million people was, at the time of the visit, supplied by two private companies and a third nationalised undertaking set up under the Peron régime. The nationalised system operated on 132 kV and 13·8 kV while the private undertakings systems used 27·5 kV and either 6·5 kV or 6·85 kV for their main feeders. There was very little d.c.

The three systems were almost entirely separate and even in the individual systems there was practically no interconnection between feeders. Voltage regulation was so poor that in some districts a nominally 225 V system yielded only 140 V. Although the use of booster transformers was forbidden, they were none the less widely used by private people.

Regulation was so bad that one system operated a separate network, picturesquely described as an "oscillating network," solely for the purpose of supplying lifts and similar installations.

While the main substations were frequently palatial structures—some even had marble staircases—most of them handled only a single incoming and outgoing feeder and although they were elaborately equipped with relaying and supervisory equipment it was little used, either because it was faulty or because of restrictive practices.

The smaller transformer substations in the city were mostly beneath the pavements and, in common with other electrical installations, had open-type switchgear. Safety precautions were almost non-existent, it being possible in most substations to touch live high-voltage busbars and gear from walkways.

The city power stations were to be augmented by a further station, now under construction by AEI. This station was to have five 120 MW sets. At the time of the visit, due to local difficulties, it had only reached the piling stage although, according to schedule, it should have been in service. When the station would be paid for was a matter for speculation.

Equipment represented the manufactures of nearly every country in the world and in consequence there was little standardisation, even phase colours varied on one system. Much trouble had been experienced with breakdowns on the 27·5 kV feeder cables used in the city, partly because the electric railway systems had no return line and the currents flowed through the supply systems' cable sheaths. The cables consisted of single-phase cores lead-sheathed, insulated overall and bound together in groups of three.

The Argentinians seemed reluctant to use overhead lines; Mr Welch gave as an example the use of four single-phase cables to link the city with a substation 20 miles distant. The substation was connected by a 400 kV line, at present energised only at 132 kV, to a power station 150 miles away. In the event of a fault on the cable system, one of the four cores was spare and could replace the damaged core. This provided, of course, the fault had affected only one core.

These comments on the Buenos Aires supply system were made by Mr Welch during the description of his impressions of the city and of his flights to and from this country, which also included Spain and the USA. Although he found the Argentinians very friendly and likeable, he said the city had a tawdry appearance with several pot-holed streets and a general air of lack of maintenance. The policies of the Peron Government, although popular with certain sections of the public, had resulted in such inflation that the value of the peso had dropped from 1s 4d to about 1d while he was in power and the régime was still a very delicate subject for discussion. Mr Welch's talk was illustrated by colour slides.

NOTES ON WIRING

BY MEGOHM

ONE small item caught my eye this week whilst scanning my evening paper. It was a paragraph saying that a Midlands building firm have employed a married woman to inspect each house that they build prior to handing over to the client. This lady's job is to spot the items which have not been correctly finished and which she herself would not accept if the house was being handed over to her as a client.

This seems a sound idea, and I was immediately struck by the common sense shown by the builder. Who better qualified than a housewife to sort out the mistakes? I wonder if the firm ever thought of providing her with an electrical testing outfit consisting of a cleaner, a refrigerator, a washing machine, etc., and letting her loose in a completed house to see if there were enough socket outlets, etc., to suit her and satisfy her needs? I think it might serve some purpose and prove to builders that if they insist that their houses are "fully equipped" then the electrical system must be up to modern standards, too.

As I so often reflect, the electrical installation in the modern house is still far from perfect and we need some fresh thoughts on this matter now. I have also mentioned before my belief that the housewife will become the person who makes the planner take notice and the above item seems to add weight to my comments.

Ring-circuits

It is becoming increasingly clear that many engineers are far from happy with the ring circuit as it stands at present. Some engineers go as far as to say that a completely wrong impression of its uses and flexibility has been circulated, and we may soon reap the bad fruits of this publicity. I hesitate to agree entirely with them, for I still feel that properly planned and installed the ring-circuit is an economic factor in installations. But, of course it is not every contractor and engineer who will take the time to study all the dangers of a badly planned installation.

More evidence is coming to hand every day, which shows that the amateur wireman has been getting information on ring-circuits from certain periodicals. I heard of an instance quite recently where one such amateur completely ruined an installation by attempting to install further sockets in the ring. He "traced" out the cable run, as he thought, and fitted two sockets into the run of cable. The occupants of the house started using fires on these sockets and found that a fuse blew. The fuse was repaired and the fires operated for some time but soon went again.

Investigation by a skilled man showed that the sockets had been inserted in the cable which served the immersion heater and the fuse had given up the ghost when the two fires and the immersion heater were all in circuit. Obviously the handyman had read all about 13 amp sockets and the ring-circuit and had assumed that it was the simplest thing on earth to add a few extra sockets to the ring.

Of course it is the main object of some publications to pass on knowledge to handymen, and whilst this state of affairs lasts we can expect trouble. By all means let the public know of the advantages to be had from the ring-circuit, but let us keep the installation of it "in safe hands."

Apprentices

I have been following with great interest public comments about the new scheme for apprentices in the contracting industry. Much can be said for and against the scheme, and I think this is a healthy sign. So much has been said about the youth of today that any scheme will come in for criticism. Do we give them too much freedom, should we call for a greater effort by them in colleges after they leave school? I really couldn't answer my own questions.

One thing is certain and that is that we must try to bring the best type of boy into the industry and, therefore, any scheme should be attractive, but at the same time it should call for a good standard of work. Can anybody really provide an answer with the industry in its present mood? Young lads are very fond of their spare time, and if classes have to be attended during that time, plus the time spent in study, then we may see a tendency for the youth to drift to another industry which has not so many "musts" about it.

No doubt many of the older engineers consider that these boys are being given an ideal chance in life—a chance which was not so readily available in years gone by.

Drawings

A matter which has troubled me in the past has cropped up again with me. This is the matter of "as fitted" drawings due from a contractor after completion of a contract. Try as I may, I cannot get any sense out of this firm, although I have repeatedly asked for these drawings. The amazing thing is that the percentage of the contract held as retention will not be released until the drawings are in the client's hands. How ridiculous can such situations get? Here is the client almost pleading with the contractor to accept the final payment and all the contractor has to do is to produce a drawing.

There may, of course, be some reason for the delay, but the only one I can think of is a financial one. The client obviously wants to settle the affair within the "financial year," so could it be that for some reason the contractor does not want *his* books to show that money this year? There appears to be more and more of this financial juggling taking place every year. Hospital boards are, of course, well known for their requests to certify as much as possible before the end of March, and at that time of the year all concerned are working at full pace to accommodate them in this wish.

Still in the field of £ s d, a well-known architect informed me that he was beginning to tire at having his ideas quashed by these accountant types who seem to be holding the reins in the building industry today. On several projects he has had to cut down on the outside finishes on his buildings although these finishes would require less maintenance over the years. A cheaper finish, which required annual attention, was chosen in one instance because it saved a few hundred pounds of *capital* cost.

Personalities *in the industry*

Mr R. H. Jeffery

Mr J. A. Barson

Mr B. E. Shea

Mr J. M. Paul

Mr L. C. Penwill

Promoted to general sales manager of AEI-Hotpoint Ltd. is **Mr R. H. Jeffery,** who joined Hotpoint in November, 1956, and in July, 1957, was appointed Northern Division sales manager. He has latterly been Southern Division sales manager. In his new position he succeeds **Mr J. M. Donald** who is undertaking a special assignment with the associated company, AEI-Gaia Ltd. Succeeding Mr Jeffery as Southern Division sales manager is **Mr J. A. Barson** who, since January, 1958, has been London district sales manager. The latter position is being taken over by **Mr B. E. Shea.**

Education and training officer to the North Western Electricity Board since 1948, **Mr P. Cheetham,** M.B.E., has been nominated to succeed **Mr H. W. Buxton,** F.C.C.S., M.P.O.A., as assistant secretary, administration, to the Board, on Mr Buxton's retirement next month. Prior to 1948, Mr Cheetham served with the Ministry of Supply and the Board of Trade (*ESH, page 155).

Mr Michael Rosslyn Symonds, A.C.A., and **Mr Richard Henry Symonds** have been appointed directors of R. H. Symonds Ltd.

Mr E. Brereton, works manager, has been appointed a special director of the Superheater Co. Ltd.

Two new appointments have just been made by the BBC. **Mr J. C. Webb,** A.M.I.E.E., becomes head of the Valve Section of the Transmitter Department in succession to **Mr H. S. Walker,** M.B.E., A.M.I.E.E., who has retired after nearly 38 years' service. **Dr R. D. A. Maurice,** ING.DR., ING.E.S.E., A.M.I.E.E., becomes assistant head of the Research Department in succession to **Mr A. B. Howe,** O.B.E., M.SC., M.I.E.E., who recently retired after 36 years' service with the Corporation. Dr Maurice joined the BBC Research Dept. in 1939 and became head of the Receiver and Measurement Section in 1943. In 1951 he transferred to television research, became assistant head of the Television Group in 1954 and head of that group in 1958.

Formerly chief engineer and manager of the Zanzibar Electricity Board **Mr J. M. Paul,** M.I.E.E., is joining the Metal Industries group as managing director of Foster Transformers Ltd. and Lancashire Dynamo Nevelin Ltd. Born in British Columbia, Canada, in 1918, Mr Paul was educated at the XIV School, Bristol, and King's School, Worcester, and received early training at Faraday Hse, London. After service in the Royal Engineers from 1939 to 1946, he served with the Central Electricity Board. In 1949 he joined the Uganda Electricity Board and in 1957 went to Zanzibar to set up the Zanzibar Electricity Board, of which he has since been chief engineer and manager.

Mr A. Threlfall, A.M.I.MECH.E., GRAD.I.E.E., has been appointed sales manager of Perkins Gas Turbines Ltd.

Mr J. H. Ford, assistant district commercial engineer at Maidstone, to the South Eastern Electricity Board, has retired after 50 years' service in the industry and, to mark the occasion, was recently the recipient of a presentation made by **Mr C. E. Hollingworth,** district manager.

Two new sales positions have been created at the MO Valve Co. Ltd., subsidiary of the GEC. **Mr N. Girton** becomes manager, home sales and **Mr C. R. Russell,** manager, export sales. Mr Girton joined the company in 1950 and became engineer-in-charge of the u.h.f. and microwave valves manufacturing section. In 1959 he was appointed assistant manager (home sales). Mr Russell began at the Wembley Research Laboratories, now the Hirst Research Centre, of GEC in 1947, where he has been closely associated with the development of the company's products, in particular with the microwave programme.

After some 36 years as chief executive, **Mr L. C. Penwill,** C.B.E., COMPANION I.E.E., director of the Electrical Contractors' Association, the National Federated Electrical Association and of the National Electrical Contractors' Trading Association, has indicated his intention to retire on 3 Feb., 1962. By that time, Mr Penwill will have served the Associations for over 41 years, for he joined ECA in 1920 as assistant secretary to the then chief executive, Mr L. G. Tate. When the latter died suddenly in Jan., 1926, Mr Penwill was appointed to succeed him. In the subsequent years he has built up the three organisations to their present high standing, in addition to handling difficult wage negotiations in a very firm manner.

Secretary of the Institution of Mechanical Engineers for the past ten years, **Mr B. G. Robbins,** M.SC.(ENG.), F.C.G.I., M.I.MECH.E., is shortly to retire and will be succeeded on 1 June by **Mr K. H. Platt,** M.B.E., B.SC., M.I.MECH.E., who joined the Institution staff in November, 1952, and has been deputy secretary since January, 1956.

Financial manager with Evershed and Vignoles Ltd. since 1957, **Mr E. F. Coppock,** F.I.C.A., F.I.C.W.A., A.C.I.S., has become group financial controller to Metal Industries Ltd. He succeeds **Mr P. Jardine** who is taking up full-time directorships with J. G. Slatter and Co. Ltd. and Minerva Mouldings Ltd., two MI subsidiaries. Educated at the City of Oxford School, Mr Coppock was budget officer with the Plessey Co. from 1951

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* *Denotes revision to the "Electricity Supply Handbook, 1960."*

to 1954 then financial and budgetary controller with Elliott Brothers (London) Ltd. until joining Evershed and Vignoles in 1957.

Manager of the Leicester sub-area of the East Midlands Electricity Board since 1948, **Mr D. H. Parry,** B.SC., M.I.E.E., is to retire on 31 March and will be succeeded in that position by **Mr D. C. Whyte,** A.M.I.E.E., who is now deputy sub-area manager there (*ESH, page 118). Mr Parry was educated at King Edward High School, Birmingham, and at Birmingham University. After early training with Willans and Robinson, Rugby, he joined the English Electric Co. in 1922 and ultimately became chief contract engineer. In 1928 he was appointed constructional engineer with the Leicester Corporation Electricity Department and three years later became chief assistant engineer in charge of the operation of the local generating station and of the distribution system. Mr Parry was chairman of the East Midlands Centre of the IEE in 1959-60 and president of the Leicester Electrical Society from 1948 to 1950. Mr Whyte completed his education at Nottingham University. He entered the electricity supply industry in 1927 and received his early training with the Derbyshire and Nottinghamshire Electric Power Co. In 1946 he was appointed assistant manager of the Leicestershire and Warwickshire Electric Power Co. and became manager of the Board's Loughborough district at vesting date. He remained in that capacity until taking up his present appointment in 1958.

After over 40 years' service with Pritchett and Gold and EPS Co. Ltd. and its predecessor, **Mr F. J. Newman,** A.M.I.E.E., has retired. To mark the occasion he was recently presented with photographic and other equipment, connected with his hobbies, by **Mr E. J. Roberts,** sales manager. Mr Newman joined the Premier Accumulator Co. in 1919, after war service, and has since been continuously associated with the stationary battery. At that time, stationary batteries were chiefly used on a large scale by municipal electricity undertakings and big private country houses and institutions. Later came the storage battery in smaller self-contained private plants. Mr Newman was closely associated with the design of the closed top type cell, combining the advantages of open and sealed types. When the Premier Accumulator Co. was taken over in 1929 by Pritchett and Gold and EPS Co., Mr Newman continued with the latter concern, and has been in charge of estimating work at the London office for many years.

Mr H. Bott, M.I.MECH.E., M.I.MAR.E., has been appointed chief engineer of Fawcett, Preston and Co. Ltd. He was previously with the National Coal Board and John Summers and Sons Ltd.

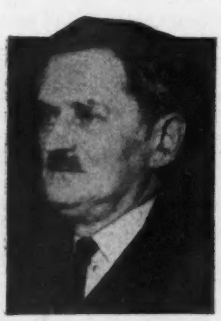
Mr N. O. K. Johnson, who has been general manager, Middle East, for Balfour, Beatty and Co. Ltd. and Balfour Beatty (Overseas), has joined the board of the latter company.

Mr A. D. Lidderdale, M.I.MECH.E., M.I.PROD.E., has been appointed general manager of Leybold-Elliott Ltd., the new company recently formed by Elliott Brothers (London) Ltd., a member of the Elliott-Automation group and Leybold's of Cologne. Mr Lidderdale, who is 46, joined Telcon in 1953 and was at one time chief engineer and manager of their Mechanical Engineering Division. He later occupied a position on the Cables Group Board and was deputy to the managing director.

Mr James Anderson, chairman and managing director of Anderson Boyes and Co. Ltd., has been appointed chairman of an organising committee set up by the Industrial Training Council to convene a Scottish conference on industrial training.

Mr J. Y. McDonald is now manager, diesel engines at the Preston works of the English Electric Co. Ltd. in succession to **Mr J. H. A. Sharpley,** who is undertaking other duties. Mr McDonald was previously assistant manager of engineering, Preston.

District manager of the East Monmouthshire district of the South Wales Electricity Board since October, 1958, **Mr G. J. Hughes,** B.SC.(ECON.), A.M.I.E.E., is joining the North Eastern Electricity Board, at headquarters, as assistant chief commercial officer (commercial and domestic). He will succeed **Lt-Col E. J. Parnall,** T.D., B.SC.(ENG.), M.I.E.E., who is retiring at the end of April. (*ESH, pages 133, 149). Mr Hughes was educated at Christ's College, Finchley, Northampton Polytechnic, Enfield Technical College and the North Western Polytechnic, London. He obtained a B.Sc. degree in Economics at the University of London. After a period in industry, he became a junior engineer with the Northmet Power Co. in 1936, later occupying posts as commercial assistant and assistant engineer with the same company, and at vesting date became first assistant to the district commercial engineer at Tottenham in the Eastern Electricity Board. In 1949 he was appointed resident manager at Potters Bar. He joined the South Eastern Electricity Board as district commercial engineer at Reigate in July, 1952, and in November, 1953, he was appointed senior assistant engineer to the sub-area commercial officer at Newport (Mon), with the South Wales Electricity Board, a position he held till taking up his present post. A native of Hampshire, Lt-Col Parnall was educated at the Isle of Wight College, Portsmouth Grammar School and Bristol University, where he obtained an honours degree in electrical engineering. He commenced as an indentured apprentice with William Geipel and Co., and after service with the Tyne Electrical Engineers, R.E., in World War I, took an appointment as a district engineer (commercial) with the Newcastle Electric Supply Co., which later became the North Eastern Electric Supply Co. He served for many years in a senior capacity in the commercial organisation of NES Co. and at vesting date was appointed to his present position as assistant chief commercial officer in the North Eastern Electricity Board. In addition to pioneer work in rural development, he invented the load rate prepayment meter which was extensively used in the north east. He was a member of EDA committees on water heating, laundry equipment



Mr D. H. Parry

Mr D. C. Whyte

Mr F. J. Newman

Mr A. D. Lidderdale

Mr G. J. Hughes

and refrigeration, and of the Electricity Council's Domestic and Commercial Loads Utilisation Research Panel.

Mr R. Payton Craig has joined the Derritron Electronics group as senior field sales engineer, acting as technical representative. He was formerly with Muzak, Taylor Instruments Ltd., and the Pye group.

Mr C. Bottomley, M.B.E., has been appointed manager of the Time Systems Division of IBM UK Ltd., in succession to **Mr E. S. Howard,** who has retired.

At a recent meeting of the Southampton University Court **Sir Basil Schonland,** F.R.S., formerly Director of the Atomic Energy Research Establishment, Harwell, was elected Junior Pro-Chancellor in succession to the late Sir Henry Tizard.

Establishment officer to the Merseyside and North Wales Electricity Board since 1948, **Mr E. A. E. Colter** is relinquishing that position on medical advice. (*ESH, page 135.) Mr Colter, who is 59 years of age, has served in the electricity supply industry for 43 years. Prior to joining the Board he was for 30 years on the staff of the Lancashire Electric Power Co., latterly as cost accountant, but his experience and duties were extended into the fields of personnel control and labour relations.

Mr F. C. Pullen, sales manager, **Mr G. O. Collier,** works manager, and **Mr E. Walley,** F.C.A., company secretary, have been appointed to the board of Ekco Plastics Ltd. Mr Pullen joined Ekco in 1941 and has been plastics sales manager since 1944. Mr Collier joined Ekco in 1939 and became plastics works manager in 1947. Mr Walley has been with Ekco since 1945 and is also chief accountant of E. K. Cole Ltd.

Mr J. Studholme, chief technical engineer of the Benjamin Electric Ltd., is now in Milan, Italy, attending the four-day meeting of the International Expert Committee on lamps, lamp caps and holders, in an effort to bring about closer international standardisation. This is one of the committees of the International Electro Technical Commission.

Mr R. H. Newton has become works director of Aberdare Cables Ltd., and it is announced that **Mr N. Care,** M.I.E.E., general manager of South Wales Switchgear Ltd. is now undertaking the additional duties of co-ordinating the sales organisation of home factories in the Aberdare Holdings Group. Mr Newton, educated at Canton High School, Cardiff, and Bootle Grammar School, served with the Macintosh Cable Co. for 15 years, where he received his training in cable manufacture, engineering and estimating. He afterwards served with British Insulated Cables Ltd. for a short period before going to South Wales as one of the first employees of Aberdare Cables when the factory was built in 1937-38. Mr Newton is one of the few present-day executives who was originally responsible for the production in Aberdare, and has held an executive position in the company ever since. He was appointed to the board in Jan., 1955. Mr Norman Care joined South Wales Switchgear in Dec., 1954, and became general manager in 1957. Prior to moving to South Wales, he was assistant chief engineer of the Midlands Electricity Board and, before vesting day, technical engineer with the City of Birmingham Electric Supply Department. Mr Care is immediate past-chairman of the Supply Group of the Western Centre of the IEE, and co-author of the IEE Paper, "Automatic Circuit Reclosers."

Ferranti Ltd. announce the forthcoming appointment of **Mr R. M. I. Hobill** to their board. Mr Hobill, who is 54, was educated at Hulme Grammar School and the Manchester College of Technology. He joined Ferranti Ltd. after training with Sir W. G. Armstrong Whitworth and Co. in 1929, serving in the transformer drawing office, supervision of outside erection both home and overseas, and technical sales until 1940 when he was appointed transformer works manager. In 1946 he became sales manager, London area; in 1951 he returned to Hollinwood as sales manager, Transformer Department. He became manager of that department in June, 1958.

Mr Christopher Chataway, M.P., has been appointed Parliamentary private secretary to the Minister of Power.

The Minister of Power has reappointed **Mr W. Newcome-Baker,** C.I.B.A.E., to be a part-time member of the Eastern Electricity Board. **Mr J. E. N. Davis** is retiring from part-time membership of the Board on 28 Feb. (*ESH, page 105.)

General manager of the International Rectifier Co. (Gt. Britain) Ltd. since joining them in Sept., 1959, **Mr K. R. Simmonds,** B.SC.(ENG.), A.M.I.E.E., has been appointed managing director of that company. He has been associated with the semiconductor industry for some time, having earlier been with Texas Instruments Ltd. as their general manager, marketing. Before that he was manager of the Radar Division of Elliott Brothers (London) Ltd. Recently Mr Simmonds, with Mr P. Ransom, the manufacturing manager, visited the International Rectifier Corporation in Los Angeles to plan further production facilities for a wide range of semiconductor devices recently developed by the American company.

Mr R. Appleby has been elected to the newly created office of executive vice-president, European operations, to the Black and Decker Manufacturing Co. Ltd. In addition to his new appointment, Mr Appleby is managing director of the British associate company, Black and Decker Ltd., Harmondsworth, Middlesex, and a director of Black and Decker subsidiaries in Belgium, West Germany and the Netherlands. Mr Appleby was first employed by the English company in 1953 as a director and later that year was named director and general manager. In 1956 he was elected managing director of Black and Decker Ltd., succeeding the late J. V. Franklin.

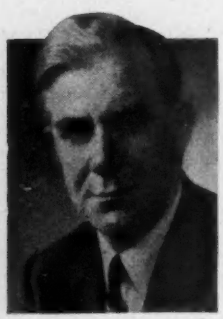
Chief commercial officer of the South Western Electricity Board since June, 1957, **Mr R. F. Richardson,** M.B.E., M.I.E.E., has also been appointed a member of that Board for a period of three years from 1 May, while continuing to serve as a full-time officer of the Board. The Minister of Power has also re-

Mr. R. H. Newton

Mr. N. Care

Mr. R. F. Richardson

Mr. R. M. I. Hobill



Mr. R. A ppleby

appointed **Ald S. H. Payne,** J.P., as a part-time member of the Board for a further period of two years from 1 April (*ESH, page 97.) Mr Richardson gained early training with Callender's Cable Co., before joining the electricity supply industry in 1936, and was a senior sales engineer with Central London Electricity Ltd. During World War II, Mr Richardson commanded a Field Park Company, Royal Engineers, throughout the North West European campaign, during which he was awarded the MBE. After a period with the London Electricity Board he joined the then British Electricity Authority, and was appointed assistant commercial manager in 1953. Associated with a number of research activities dealing with the use of electricity Mr Richardson has for some years also been concerned with economic studies affecting the development of electricity in this country and elsewhere; he was for a time the UK delegate on an OEEC group of experts dealing with electricity prices. Mr Richardson was at the Administrative Staff College in 1954, and is closely interested in training and management development.

The following members have been elected to fill the vacancies that will occur on the Council of the Institute of Metals at the coming annual meeting: **Prof H. O'Neill,** president; **Sir Ronald Prain,** past president (chairman and president, Rhodesian Selection Trust); **Mr W. F. Randall** (deputy chairman and managing director, Telcon Metals), and the **Earl of Verulam** (chairman of Enfield Rolling Mills), both vice-presidents. **Mr N. I. Bond-Williams, Prof A. H. Cottrell** and **Mr G. A. Rider** have been elected ordinary members. The Earl of Verulam has been elected to serve as senior vice-president for 1961-62.

Croydon area sales superintendent of AEI Lamp and Lighting Co. Ltd., **Mr W. Steer** has retired after 40 years' service in the industry. Mr Steer assisted in the production of the first electric soldering iron and the manufacture of electro-magnetic separators as manager of Cavendish Electric Co. Ltd. He joined BTH in 1932 and was appointed manager and opened the Ilford depot six years later. In 1942 he moved to Croydon as manager and was appointed Croydon area superintendent on the formation of AEI Lamp and Lighting Co. Ltd.

Mr E. E. Caffyn, B.SC.(ENG.), of Power Rectifier Sales Department, AEI Heavy Plant Division, Rugby, retired on 31 Jan. after over 48 years' service. He joined BTH in the Test Department and subsequently transferred to the Contract Department where he continued for many years, apart from war service and a year in the Construction Dept. In 1927-28 the company began to manufacture rectifiers and, since that time, he has handled many large contracts. When a Rectifier Section was formed shortly after the second world war, he was placed in charge, a position he relinquished some two years ago, since when he has dealt with various special assignments.

The Eastern Electricity Board have appointed **Mr B. W. Ricks,** M.I.E.E., A.M.B.I.M., to be their deputy chief engineer to succeed **Mr E. P. Burdett** who is to retire later this year. Mr Ricks, who is at present the engineer of the Northmet sub-area, will also become the Board's operational research engineer.

OBITUARY

Mr A. A. Anderson, assistant district engineer, South Angus district of the North of Scotland Hydro-Electric Board until retiring in August, 1959, died on 29 Jan., aged 66.

Mr J. M. Barker, formerly district commercial engineer at Ashington to the North Eastern Electricity Board, has died. He retired 18 months ago.

Mr A. W. C. McArthur, formerly a director of W. T. Henley's Telegraph Works Co. Ltd., died on 28 Jan., aged 75. He was works manager of the Woolwich works from 1939 to 1952 and, in addition, was works manager of Birtley works from 1950. He retired in 1958.

Mr Andrew Young, formerly chief draughtsman, London Division, CEGB, died on 4 Feb.

Mr C. F. Matthews, B.SC., A.M.I.E.E., formerly with the Newbury sub-area of the Southern Electricity Board, has died, aged 59. He was a keen advocate of low promotional tariffs, on which subject he contributed to our pages on several occasions. He also gave evidence before the Herbert Committee on the application of TVA methods in Britain.

Mr W. G. Heath, M.I.E.E., who founded the Plymouth electrical contracting concern of that name in 1898, has died, aged 82. A founder and a Fellow of the Electrical Contractors' Association, he was a past chairman of the local centre of the IEE. He had also been a director of Brittanic Electric Cables Ltd., Rediffusion Ltd. and other companies.

NEW LITERATURE

Thyratrons

by C. M. Swenne

TO find a book on an electronics subject almost devoid of mathematics is a refreshing experience. This book, in the Philips popular series, explains in clear language the action and construction of thyratrons and how they are used in circuits. After a note on the physical principles of their operation, the book outlines the methods of control used. The author describes basic circuits and the application of peaking transformers to give a precise operating point on the thyratron characteristics. For the practical engineer, circuits complete with component ratings are given and include a photo-electric relay, a thermostat and both d.c. and a.c. contactors. Two other circuits of particular interest are for dimming fluorescent tubes and for a small inverter. The book concludes with a table of the Philips thyratrons available. Published by Cleaver-Hume Press Ltd., 73 pages, 8¼ in. by 5¼ in. Price 12s 6d.

H.V. D.C. Power Transmission

by C. Adamson and N. G. Hingorani

A COMPREHENSIVE study of the basis of high voltage direct current transmission techniques is a valuable gain to engineering literature at the present time. For British engineers, the Channel crossing and the New Zealand Cook Strait schemes are in the news, while on the world stage, Russian projects attract attention. The present book should fit the needs of the engineer who finds himself involved with one or other of these projects and wishes for an introduction to the technology which goes into detail. Mercury rectifier valve characteristics are discussed and the essentials of connection and control analysed. The difficult question of protection receives attention, with an eye to future developments and in the latter part of the book some practical system consideration are discussed. Earth return arrangements, harmonics, insulators, corona and d.c. cables and, naturally, the internal construction and operation of mercury-arc rectifiers all receive attention. Over this whole range, the information is presented in a readily assimilable manner and backed by an extensive bibliography of a scattered literature. Published by Garaways Ltd., 284 pages, 9¼ in. x 7½ in. Price 84s.

Television Explained

by W. E. Miller, M.A., M.BRIT.I.R.E.

SEVEN editions in 13 years not only indicates the rapid changes that have taken place in television receiver design, but also the popularity this little book has enjoyed among amateur, professional and non-electrical enthusiasts. This edition, revised by E. A. W. Spreadbury, includes a description of combined FM and television receivers with mention of the latest wide-angle tubes. Published by Iliffe and Sons. 184 pages, 8½ in. by 5½ in. Price 12s 6d. (Seventh edition.)

Silicon power rectifiers

MANUFACTURE, CHARACTERISTICS AND APPLICATION

POWER rectifiers constructed from single-crystal silicon are now well established in industrial use. Last week at a meeting of the IEE Utilisation Section, current practice in relation to their manufacture and application was discussed on the basis of a paper* by four AEI engineers.

Silicon rectifiers represent the most recent step in a succession of solid-state power rectifiers developed during the last 40 years. Table 1 shows the way characteristics have developed. Construction of a silicon rectifier begins

Table 1. Solid-state Rectifiers.

Construction	*Reverse rating*	*Forward drop*
Copper oxide	6 to 12 V	0·3 V
Selenium	30 to 40 V	0·7 V
Germanium	300 V	0·5 V
Silicon	600 V	1·1 V

with preparation of the silicon to a state where impurity content is less than 1 in 10^9. Raw material being prepared commercially meets this requirement, although it will need further processing for conversion into single-crystal form, necessary for efficient operation of the rectifier. Another necessary manufacturing process, often carried out at the same time, is introduction of a minute amount of a suitable impurity, to give the silicon its required resistivity. Phosphorous is commonly used for n-type crystals (those with excess electrons) and boron for p-type.

Fig. 1 shows the basic arrangement of a p-n junction rectifier element and also the encapsulated form in which it is marketed.

In relation to the current-voltage characteristic (Fig. 2) it is found that the higher the resistivity of the silicon, the higher is the avalanche voltage which sets a limit to the rectifier voltage rating. For example, with n-type silicon 1 ohm-cm will give 48 V; 10 ohm-cm, 270 V; and 100 ohm-cm, 1,500 V. In practice, certain limiting considerations apply, and for high-voltage n-type rectifiers suitable for 200°C operation, a resistivity of about 70 ohm-cm is optimum.

From arguments relating to the electronic process of rectification, it turns out that the thickness of the central base region of n-type silicon should be about 0·003 in. Taking into account penetration of materials during the formation of the p-n junction and the ohmic contact, this indicates a certain wafer thickness of 0·008 in. to 0·010 in., and to allow for removal of material in manufacture, slices of silicon have to be cut between 0·014 in. and 0·018 in. thick. Junction area is related to internal temperature rise with full load current flowing, and in practical rectifiers a density of 500 A/sq cm is permissible for small area (1 A) type falling to about 80 A/sq cm for large area (200 A) type.

The p-n junction may be formed by alloying aluminium to n-type silicon or gold antimony to p-type silicon. Alloying is secured by placing a foil on the silicon surface, or by evaporating a thin layer of aluminium on to the surface, and then heating. More recently, a diffusion process has been developed in which a suitable impurity is diffused into solid silicon by heating these substances together for a prolonged period at a temperature of about 1,250°C. Diffusion offers the possibility of more convenient production and closer control of characteristics, but the necessary temperature is a disadvantage. The authors suggest that from the performance viewpoint there is little to choose between the two methods. Manufacturers who started production using the earlier alloying process can see no reason to change.

Ohmic (non-rectifying) contact formation is carried out at the same time as alloying, using suitable foils.

Finally, in cell formation, it is necessary to enclose the rectifier (Fig. 1). This is essential because most of the reverse current in a silicon rectifier flows through the surface layer, which is extremely sensitive to contamination. Before encapsulation to provide this protection, all contaminants have to be removed from the surface of the rectifier by suitable cleaning and drying processes. Fig. 3 shows some of the complete cells developed.

Rectifier Properties

In theory, two temperatures can be found at which silicon and germanium rectifiers have similar characteristics. For instance, if the temperature of germanium is taken as 75°C, the corresponding temperature of silicon to give the same resistivity will be about 250°C. At present, it is not possible to make silicon rectifiers with reverse characteristics at 250°C as good as those of germanium rectifiers at 75°C, mainly because of surface effects. However, it is possible to take advantage of the higher equivalent temperature of silicon by limiting the temperature of the junction to, say, 150°C, and using the consequent reduction of reverse leakage current to give a higher permissible voltage for given reverse power loss. This approach makes it possible to use silicon at voltage ratings higher than with germanium for operation at normal ambient temperatures.

At equivalent working temperatures, the forward characteristic of a silicon rectifier is similar to that of a germanium rectifier so long as current densities are less than 100 A/sq cm. In both cases there are two components, an exponential component having a negative temperature coefficient and a resistive component with a positive temperature coefficient. The latter becomes appreciable above the 100 A/sq cm density, so that beyond this point the forward voltage drop with silicon is somewhat higher than with germanium at the equivalent temperature. In discussing current densities, the precise application of the term has to be kept in mind. For example, the typical figure of 80 A/sq cm quoted earlier is a mean current density. With three-phase double-way operation, the rectifier cell will, in fact, be operating at 240 A/sq cm

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* Paper No. 3362: "Silicon Power Rectifiers," by A. J. Blundell, A.M.I.E.E.; A. E. Garside, B.SC.(ENG.), GRADUATE I.E.E.; R. G. Hibberd, B.SC., A.M.I.E.E.; and I. Williams, B.SC., A.M.I.E.E. (All the authors were with AEI at the time the paper was written; Mr Hibberd is now with Texas Instruments Ltd.)

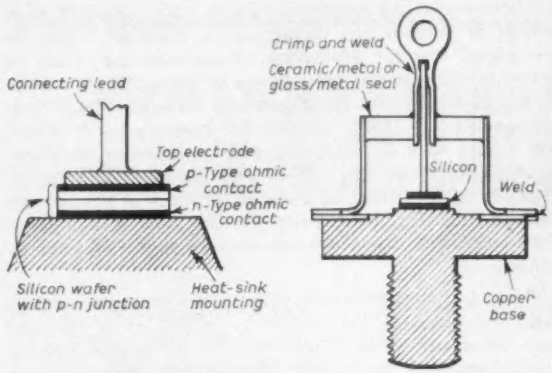


Fig. 1. Basic p-n junction rectifier with, right, basic cell encapsulation

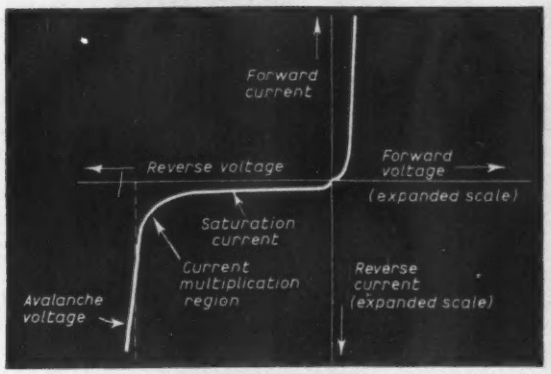


Fig. 2. Typical current-voltage characteristic of p-n junction rectifier

for one-third of its cycle, so the resistive component is important even at normal working current.

In deciding the rating of a silicon rectifier, the first consideration is maximum junction temperature. This may be chosen to give any desired compromise between ambient temperature, peak reverse voltage and maximum forward current. For instance, where a high reverse voltage is required, a junction temperature of 120°C to 150°C can be used, while for lower voltage, higher current or high ambient temperature applications the junction temperature can be increased to 200°C to 250°C.

Reverse voltage rating is subject to two main considerations. One limit is set by the ability of the cooling system to remove heat, but there is also a negative resistance type of breakdown which is initiated in a few micro-seconds, and so does not depend on duration of applied voltage. Thus, a power limit can be applied to determine the crest working reverse voltage, a value which ignores all voltage oscillations and transients; while experimental determination of onset of negative resistance breakdown is used to give a peak value of permissible surges. As an example, one 200 A rectifier has a crest working reverse voltage of 300 V and maximum recurrent and peak transient reverse voltages of 600 V. For smaller rectifiers, only one reverse voltage rating is usually noted.

Forward current rating is determined by the cooling system used and can only be stated in the context of a particular assembly. For high-power rectifiers, surge rating may set a limit to maximum forward current, this being the short-circuit current which can flow through the rectifier until interrupted by fuses or circuit-breakers.

In considering operation of a silicon rectifier, the overriding importance of the very small internal loss has to be kept clearly in mind. For example, with a rectifier cell having a peak working voltage of 300 V and a forward voltage drop of 1·1 V, the cell efficiency is better than 99%; but the less than 1% internal loss controls almost entirely the conditions under which the cell may be used. This directs much attention to design of cooling fins and study of heat flow.

In general, silicon rectifier cells may be operated in series or parallel combinations without restriction. Parallel working is usually needed only for high current rated cells, and in manufacturing these, close control of characteristics is exercised. With series working at moderate voltages, care must be taken to avoid excessive differences in the instantaneous voltage appearing across different cells. The voltage will be non-uniform if the reverse voltage/current characteristics vary from cell to cell, or if there are variations from cell to cell in the delay time at the end of rectification (minority-carrier surge time).

Cases of non-uniform voltage sharing may be cured by connecting a resistor or capacitor across each cell, but this has certain disadvantages and may involve accepting a lower average voltage per cell than in their absence. Series operation gives increased reliability, and in applications where this is more important than economy it may be preferable to use, say, two 300 V cells in series for 600 V outputs, rather than one 600 V cell.

Applications

The authors consider that the silicon rectifier is eminently suitable for any installation having ambient temperatures up to about 150°C. However, particular qualities of the rectifier point to certain applications in which its advantages are outstanding. Amongst them are high-power electrolysis, particularly when the direct voltage exceeds 250 V; traction applications, including power supply to motors; low and medium power supplies for electronic apparatus (the low forward voltage drop offers good regulation characteristics) and aircraft applications. An important specialised field of application is in the brushless alternator. In these machines, output from a

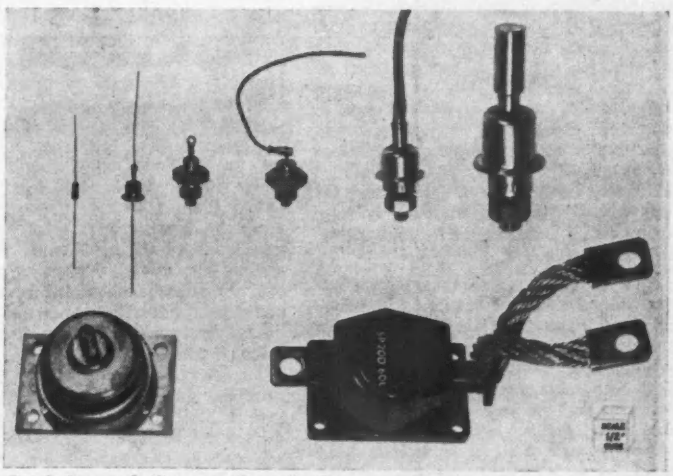


Fig. 3. Range of silicon rectifier cells. Top row, left to right, miniature wire-ended type; 1 A wire-ended type; low-current stud-mounted type; cells for 10 A, 30 A and 60 A. Bottom row, left, 100 A cell for aircraft applications; right, 200 A cell for industrial use. (Courtesy of AEI)

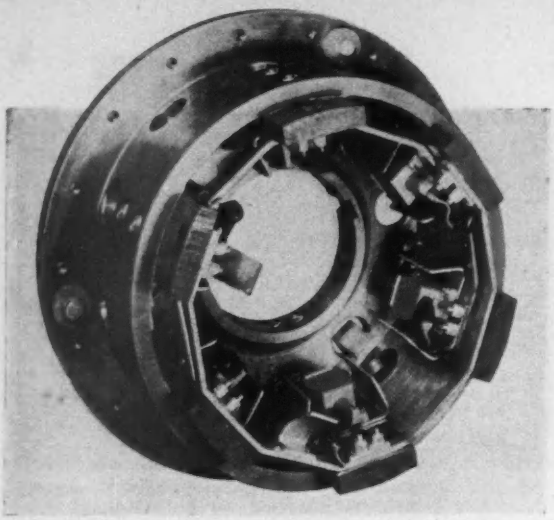


Fig. 4. Silicon rectifier assembly for marine 1,000 kVA alternator

rotating armature a.c. exciter is rectified by silicon rectifiers mounted on the rotating shaft. In one example quoted, rectifiers were rotated at speeds giving accelerations of 2,500 g with satisfactory results.

Silicon-controlled rectifiers, which have characteristics similar to those of the thyratron, are discussed briefly in the paper. Current production possibilities are noted as covering operation at voltages up to about 400 V with a 10 A cell, having been developed with forward voltage drop of about 1·5 V. Cells suitable for currents up to about 100 A have been demonstrated, and in presenting the paper the authors spoke of 150 A cells being in process of engineering. In principle, there is no limit to the current rating of the silicon-controlled rectifier, since it is of sandwich construction and its area can be made as large as convenient.

The paper concludes overall that the silicon rectifier will take the place of the selenium rectifier as a standard type for many years. It may be that for special applications, operation at ambient temperatures higher than is possible with silicon will be required. In this connection, work is proceeding on compounds such as silicon carbide, gallium arsenide and aluminium antimonide, with a view to developing rectifiers for use in the temperature range 250°C to 500°C. Low-voltage silicon-carbide rectifiers have already been demonstrated operating at 500°C.

DISCUSSION

MAJOR L. H. PETER thought the authors were perhaps being premature in claiming that the silicon rectifier was the ultimate in semiconductor rectifiers. It might prove possible to grow crystals from substances with energy gaps higher. In relation to manufacture, he said that devices at present were produced by technological physics"; almost no machinery was used. Purities had to be higher than for almost any other application.

MR J. E. BOUL (EE Co.) commented on the differences apparent in several parts of the paper between the type of ratings given to small- and medium-current rectifiers and those given to large-current rectifiers. He wondered whether there was a time limitation applying to transient ratings in higher power cells and asked why this was. He criticised the acceptance of an internal power loss under reverse voltage conditions as high as 10% of forward loss at full-load current. He thought it was an order of magnitude too large. On the subject of surge ratings he said it was common to find that short-circuit current possibilities, rather than maximum continuous ratings, fixed the number of cells needed in a series string for a given task. On the whole, Mr Boul thought it right that smaller cells should be regarded as distinct from larger.

MR A. LANGRIDGE (Westinghouse) described typical faults that could be found in crystal structure in semiconductor materials and went on to deal with effects of thermal fatigue. Various materials had been tried for the link between the junction and the base, with hard soldering the really satisfactory method. Properly used it gave an infinite life.

MR D. R. COLEMAN (STC) found himself in general support of the authors' statement although he queried whether the 600 V limit suggested as applying to silicon rectifiers was now realistic. Cells for higher voltages were being marketed and also cells with much better peak transient reverse voltage performance than 1 kV. Like Mr Boul, he took up the question why large and small rectifiers should be treated differently. He welcomed suggestions offered by the authors for defining reverse voltage, saying that misunderstanding about definitions was a cause of "confusion, suspicion and distrust" between manufacturer and user. He was happy to find that it seemed that the authors thought that germanium had been superseded and, finally, he called for standardisation of encapsulation.

MR R. A. A. NEWMAN (Westinghouse) said that experience had shown that breakdown under surge current conditions could take place merely due to mechanical stress in the cell. Faults from this cause could be eliminated if all cells were given a very short-time overcurrent test. On thermal fatigue he said this showed itself by increase in thermal resistance between the junction and base after several severe current surges. For this reason it was wise to avoid having too many surges. He thought the reverse loss in a silicon diode should be only about 2% of the forward loss. He suggested that in testing prototypes much could be learned by cycling with electrically applied heat and forced-air cooling alternately, without reverse voltage, and subsequent electrical testing. An advantage of this technique was that the diode was not completely destroyed if failure occurred.

MR A. GAVRILOVIC spoke on some problems of switching controlled rectifiers in series. He suggested that use of capacitors to control voltage sharing was not always satisfactory in such cases.

MR W. R. TAYLOR (Hackbridge) suggested that a problem that had to be faced with medium power devices as distinct from large was that they would be used in systems less thoroughly engineered and so more liable to troublesome surges.

MR P. W. BROWN called for simpler classification of ratings of devices. He also asked about working of s.c.r. inverters into inductive loads, in which duty there seems some difficulty compared with use of thyratrons.

MR F. T. BENNELL thought germanium had been dismissed too readily. The low voltage drop obtained with germanium cells was important in circuits such as those for electroplating, where total voltages as low as 8 V were involved.

In the course of their reply the AUTHORS emphasised need for standardisation, particularly in relation to terminology. A general difficulty was that the silicon rectifier had originated in the light current section of the industry, where there was less concern with overload margins. This accounted for difference in practice between small and large rated cells. In the higher rated cells the crest working voltage allowed a safety factor, the rectifier being able to stand momentarily much higher voltage provided the associated energy conveyed was low.

They did not see any reason for limiting reverse power loss to 2% except for thermal stability considerations. Provided the power loss left the rectifier stable, then the effect on efficiency was so small that there was no point in imposing an upper limit.

Replying to suggestions that rectifiers rated higher than 600 V were available, they suggested that the 600 V limit was about the highest for which rectifiers in large-scale production were available. They agreed that standardisation of encapsulation was urgently needed.

Thermal cycling was a problem that had not shown up with germanium rectifiers because of the lower temperatures involved. Each manufacturer seemed to have produced his own solution to this difficulty.

PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

Using "Waste" Material

IT is common knowledge that the waste which occurs on building sites is "nobody's business," nor is the electrician's work an exception. One contractor I know has a large red notice prominently displayed in the stores with the legend: *"A clip on the wall is worth ten on the floor."* On the subject of clips, short ends of p.v.c. sheathed wire which are usually left lying around on the job can make efficient saddles on carcassing work. Cables in the floorspace, before being covered by plasterboards, are often "supported" by an assortment of nails picked up from the floor; at times the sharp edges of the nails even cut through the insulation. On building jobs the p.v.c. wire saddles and p.v.c. straps are superior to metal buckle clips for holding several cables together, with the added advantage that extra wires can be added or drawn in without damage, so making the use of p.v.c. insulated wires into a rewirable system rivalling its screw-conduit counterpart.—*Michet.*

Filing Trouble

IN a science laboratory we had to test some equipment. The insulation standard which had been set was to be 100,000 MΩ between poles and also poles and earth with switches on the panel in the "off" position. The room atmosphere was dry and warm and we expected to achieve the value without difficulty, but the instrument only showed 200 MΩ on the positive/earth test. After careful examination, the low reading was finally traced to a fibre washer under the input terminal mounting which had a small quantity of metal filings embedded in it. Apparently the instrument had been assembled on a bench where metal filings from another process were lying around, a warning to those engaged on assembly work in such surroundings.—*F. R. Ralph.*

Domestic Difficulties

STRANGE things happen in domestic wiring installations. On the approach of a thunderstorm a careful consumer switched off his lighting supply, via a 250 V 15 A d.p. i/c switchfuse. The storm over he closed his main switch, but failed to obtain any lights. His fuses were intact and a standard lamp plugged into a separately switched power circuit lit.

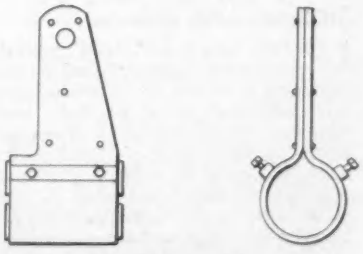
At this point he rang us, suggesting that the supply company's fuse of his two-phase and neutral supply had blown for some unexplained reason, but a test soon showed that the fuses were intact. Closer inspection revealed that one copper switch contact had failed on the bend and dropped off when the switch was opened. On reclosing the blade failed to make contact, hence, no light.

Another careful consumer, having two 100 W lighting points on one switch in his living room decided, before going out one night to leave the light on nearest the window and to save current by removing the other lamp with the aid of a duster while the current was on. On the attempt being made a minor explosion occurred in the lampholder and the lamp went out, but the other lamp remained alight. He concluded that the lamp had failed, but a new lamp inserted in the holder failed to light and he called us. With the switch off, we examined the lampholder to find one flex completely and neatly burnt through where it had been brought down and across through the slot in the moulded dividing piece to the opposite terminal. It was obvious that the act of removing the lamp had pushed up the solid terminals and one screw head had pierced the soft rubber insulation of the flex loop to the other plunger.

A 15 A fuse on the circuit had resulted in the flex being burnt through without the fuse failing. Needless to say, fuse, flexibles and lampholders were all changed. The original lamp, once current was restored, proved to be intact.—*R. Smedley.*

Lifting Rotors and Armatures

THERE is no doubt that many mechanical and electrical failures of rotors and armatures are directly brought about by rough handling before fitting. This applies particularly when lifting a heavy armature by means of sling chains, the lack of a correct means of attaching the chain to the shaft ends causing the trouble, to say nothing of the need for a stretcher-board to protect the end windings from abrasion by the chain.



A simple and effective lifting device for motor armatures prevents damage to end windings

Lifting clamps, as sketched, are well worth making and their use will enable members of the "heavy gang" to handle armatures with a greatly reduced risk of damage. Protection of the armature shaft bearing surfaces is effected by incorporating a pair of old split brass bearings, the bore being great enough to take the largest shaft handled; smaller shafts can be accommodated by facing away about ½ in. from the meeting surfaces of the split bearings.

The clamps are bent from $\frac{3}{16}$ in. boiler plate steel, the internal diameter being determined by the size of the largest armature shaft plus the protective split bearings. After forming the clamps, lengths of 1 in. by ½ in. mild steel are welded to each side of the lifting arm. These are drilled and tapped ½ in. B.S.F. to take hexagon headed set screws which serve to clamp the split bearings on to the shaft ends before lifting the armature.—*S.F.*

Air Pressure Alarm

ASSUMING that *Centri* is referring to an a.c. supply in his letter (5 Jan), a capacitor would prove more reliable to shunt the pressure switch since it would have an infinitely longer life than another lamp. Typical values I have used are an 0·1 mf with a 15 W signal lamp, which gives approximately half-brightness on a 240 V 50 c/s supply. Values for lamps of other watt loading can easily be calculated or capacitor manufacturers will advise if approached.

Regarding Mr Ralph's letter on the same page, dealing with remote control of a public hall main switch, wouldn't a key-operated switch prevent misuse? There are quite a number of manufacturers who include these in their catalogues and the keys could be kept in the possession of responsible persons only. There are many cases where installation details can be improved upon, operationally, financially and in appearance, when the person concerned with the electrical installation has a thorough knowledge of the wide range of equipment which manufacturers have to offer. —*R. T. Clarke.*

[*Mr Clarke's suggestions offer alternative methods of dealing with the problems but, in regard to the second point, keys have a habit of becoming mislaid!—Ed.*]

new products and appliances

Self-fluxing winding wire

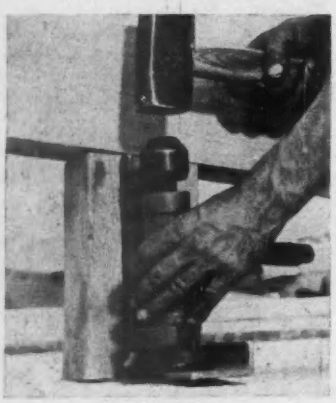
TO meet the growing demand for solderable superfine enamelled wires the "Lewcosol" range has now been extended to include wires of only 0·0010 in. dia. Other new sizes are 0·0012 and 0·0014 in. dia. *The London Electric Wire Co. and Smiths Ltd., Leyton, E.10.*

Industrial projection c.r.t.

A NEW c.r.t. for large-screen projection of industrial television pictures and data-handling information has a 5 in. dia tube face and operates at an anode voltage of 50 kV. The white light screen phosphor gives an output of 2,183 ft lamberts, which enables an optical magnification of 40 times; thus, it is possible to obtain display heights of 12½ ft from a 72 mm. by 96 mm. raster. Resolution is said to be better than 625 lines for an average beam current of 500 μA. The neck and bulb of the tube are specially insulated as a safety precaution against voltage puncture and there is an internal "spark trap" to prevent flashover between anode and grid. Tubes with red, green or blue phosphor screens can be supplied if required for colour projection. *Mullard Ltd., Mullard Hse, Torrington Place, W.C.2.*

Heavy-duty fixing tool

THE new DX500 tool for driving nails into concrete is designed to give stable fixing to installations where pull-out forces of up to 4,500 lb/fixing have to be resisted and where regulations demand bolt diameters of ¼ in. Typical applications of it are in heavy switchgear and boxes, difficult ceiling fixings, and machine and cable anchorage. It is a heavy-duty version of the earlier DX1001 tool, which remains available for lighter work. Retained features include complete safety during operation, ability to use the tool with or without cartridges and ease of changing from use of nails up to 4 in. to the fixing of a large range of internally or externally threaded nuts. Captive plunger is restrained on over-driving even by the heaviest charge without the need for resetting. Gases do not escape through the nozzle, blackening the fix, but leave by ports well away from the operator. The tool must be pressed against a surface for it to operate and a hammer-blow on the head is required to detonate the cartridge. There is a protective shield against splatter of small pieces of concrete or flint and the tool will not operate if this has been taken off, nor will it operate when it is more than 6° out of perpendicular to fixing surface. *Ucan Development Ltd., 62 Hill St, Richmond, Surrey.*



Ucan's new DX500 fixing tool

Santon catalogue revisions

A FEW price changes appear in Santon's new catalogue for February, March and April. "R" type immersion heaters are affected; 1 kW heaters IR/112 and IR/212 are increased in price to £5 15s 4d and £6 11s 11d tax paid, respectively. IR/312, 2 kW model is now priced £7 4s 11d tax paid. The QX2 domestic central heating units of 9 kW and 12 kW are now free from purchase tax. BCU 1005 Bakelite control unit has been reduced in price to 14s and there has been a general small increase in prices of thermal storage heaters.

Satchwell VK thermostats are now uprated to 20 A. Dual immersion heater controls SCU 3000 and 3003 have been withdrawn and are replaced by FSU 1, which is suitable for surface or flush mounting. Price £1 7s list. A new 30 A double-pole control unit, BCU400, is introduced. It is available in white, with a pilot light, at 14s. *Santon Ltd., Somerton Wks, Newport, Mon.*

Miniature oxide resistors

USEFUL feature of "Metox" general-purpose miniature metal oxide resistors is the inclusion, with the usual performance data, of a specified "total excursion" range. This is a percentage expressing the resistance change of the component over a given period of continuous service, in this case up to three years. This facility considerably assists the circuit designer, when choosing a suitable component, to make accurate allowances for overall long-term resistance variations. The ranges of resistors available are covered by three power ratings, namely, ½ W, 1 W and 2 W, these being sub-divided according to excursion range. Typical resistance range available in the 10% excursion category is 47 ohms to 270 kilohms. Resistance elements are each protected by a moulded jacket. *Welwyn Electric Ltd., Bedlington, Northumberland.*

Silicon controlled rectifiers

FURTHER improvements in the trigger characteristics of silicon controlled rectifiers are represented by a reduction of maximum trigger current from 150 mA to 100 mA. Corresponding maximum voltage required has been reduced from 5 V to 3·75 V. This improvement will have particular significance with regard to pulse triggering techniques. *AEI Electronic Apparatus Division, Carholme Rd, Lincoln.*

Torque and speed control

EASY installation with minimum of maintenance are two of the features claimed for the TASC model BCB motor controls. This gives 20:1 speed control with good regulation and is intended for ½ and ¼ h.p. motors driving conveyors, test rigs and similar applications. The electronics control equipment is mounted on two panels which plug-in to the power pack chassis. A similar unit gives close speed regulation over a range of 50:1. *Pye Electric Ltd., Oulton Wks, Lowestoft.*

Electro-hydraulic load gauge

A RECENTLY introduced device for crane-overload detection and similar applications consists essentially of a shallow, fluid-filled cylinder having a piston bonded to the walls by means of a flexible rubber joint. The applied load is transmitted to the fluid by the piston, which can tilt to accommodate any eccentricity, the fluid pressure being converted into an electrical voltage signal by means of a Bourdon-type pressure transducer. The electrical output is sufficient to operate an alarm or control relay without the need for amplification. The unit is fabricated in forged steel, having a top dome housing the transducer and a crane-hook to support and transmit the load. Electrical output is fed via a triple-core flexible lead and de-mountable connector. *General Electric Co. Ltd., Magnet Hse, Kingsway, W.C.2.*

For crane weighing and similar applications GEC have introduced this electro-hydraulic cell with in-built transducer

Imported electronic components

IT has been announced that the complete range of electronic circuit components manufactured by the Canadian subsidiary of Burnell and Co. Inc., of California, is now available in the UK. The range includes variable inductors, subminiature and encapsulated toroids and various network filters. *Aero Electronics Ltd., Gatwick Airport, Horley, Surrey.*

Silicon miniature diodes

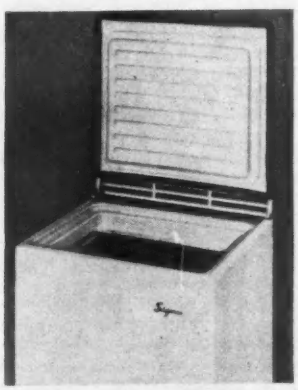
TWO new miniature silicon diodes have been added to the existing range manufactured by Joseph Lucas, who also announce further price reductions. The new devices are the "DD007" and "DD008" having peak inverse voltages of, respectively, 600 V and 800 V. Price reductions are said to have been achieved by improved production techniques. *Joseph Lucas Ltd., Gt. King St, Birmingham 19.*

Domestic freezer

A NEW freezer cabinet with 3·2 cu ft capacity is announced. It is a chest-type freezer, manufactured as the T90 commercial and TT90 domestic model, the two differing only in design of the lid. TT90 has a plastic heat-resistant scratchproof working top attached, while the top on the commercial model is removable. Cabinet is white, 2 ft 9½ in. high and 1 ft 11½ in. wide by 1 ft 11½ in. deep. Internal finish is in aluminium and each model is supplied with two storage baskets. The freezer is operated by a "Danfos" sealed compressor. Retail price of £89 5s for the TT90 domestic model includes purchase tax. T90 commercial is priced £75 12s. Distributors of the new freezer, which is known as "Sigma-Frigo-Therm," are *Electro Appliances and Equipment Ltd., Mitre Hse, 177 Regent St, W.1.*

Infra-red photo-cell

A NEW photo-conductive cell, claimed to have a higher detectivity than any other type at present commercially available for infra-red applications, has been recently introduced. Known as the "ORP13," it has been developed specifically for use in infra-red spectroscopy and research into the properties of materials. Spectral range of its indium antimonide sensitive area is from visible to about 5·4 micrometres, the peak sensitivity occurring at between 4·5 and 5 micrometres. Sensitivity to monochromatic radiation is 15 mV/μW of incident radiation. *Mullard Ltd., Mullard Hse, Torrington Pl, W.C.1.*

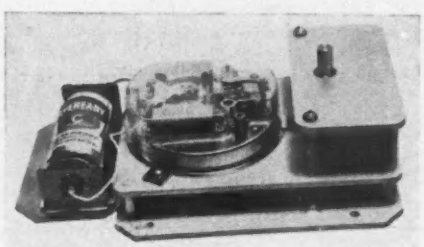


▲ *"Sigma - Frigo - Therm" freezer cabinet £89 5s*

Chronometrically governed motor

OF two new small d.c. motors announced by an American company, the first is chronometrically governed for applications such as chart drives and accurately timed actuation of contacts and cams. This motor is claimed to operate for over two years on a single 1·5 V dry cell, with a constant speed of 150 r.p.m. maintained by balance-wheel and hairspring escapement. This controls the length of current pulse fed to the motor in inverse proportion to the e.m.f. of the cell, which, of course, varies according to the current drain and degree of polarisation. Accuracy claimed is ±10 sec in 24 hours for input voltage variation from 1·8 V to 0·9 V. The motor has dimensions of 1¼ in. by 2¼ in. by ½ in. and weighs only 3 oz. Windings for voltages from 0·5 V to 12 V d.c. can be supplied to order.

The second motor available is for rotary stepping applications. This is achieved silently, without the use of electrical contacts or mechanical ratchets, by alternately energising two windings on the motor with a series of pulses which can have a repetition rate of up to 2,400/min. Each pulse causes the rotor to advance through 15 degrees. Consecutive pulses to the same winding will have no effect on the rotor. This facilitates control since a switch inserted in either winding connection can be used to stop rotation. The motor is rated at 27 V d.c. and is said to give an output torque of 0·2 oz in. *A. W. Haydon Co., Waterbury, Conn., USA.*



Chronometrically governed d.c. motor. Designed for such applications as chart drives and actuation of contacts and cams, it is said to operate for two years on a 1·5 V dry cell ▶

Transient voltage detector

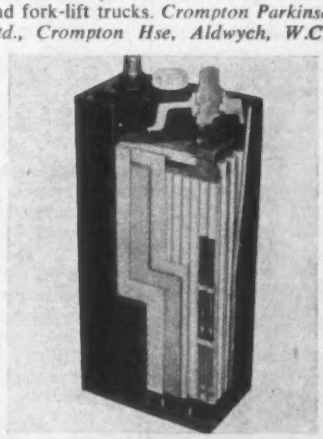
THE problem of attentuating switching surges likely to occur in electrical apparatus is facilitated by the use of a recently introduced transient voltage detector. When connected to the circuit under test this will show the test transient as a fixed image on a c.r.o. The circuit parameters of resistance and capacitance can then be altered by trial and error until the amplitude of the surge is reduced to its lowest possible value. The detector unit is housed in a steel case having front panel dimensions of 6 in. by 7 in., the unit weighing only 5 lb. Input voltage is 230 V a.c., and consumption 2½ W. Price excluding oscilloscope is £30. *Portable Welders Ltd., Castle Mills, Buckingham.*

Spring-loaded terminal block

A NEW flexible terminal block has been added to the standard range of Hellerman "Suprafix" spring-loaded terminal blocks. This new 12-way block incorporates the normal spring-loaded device whereby a button is depressed and the stripped cable end is inserted into its appropriate terminal and firmly clamped into position by releasing the button. Rating is 10 amp at 380/470 V. The form of connection used is claimed to remain absolutely secure even under conditions of vibration. *Hellerman Ltd., Bowthorpe Electric Co. Ltd., Crawley, Sussex.*

High-capacity accumulator

A NEW secondary battery having a volume-for-volume storage capacity claimed to be at least 32% greater than standard types, has been announced. The secret of this improvement lies in the form of plate construction employed. Each positive plate consists of a number of vertical spines integral with a connecting piece, the whole being cast in lead alloy. Active material is held in intimate contact with each spine by means of a surrounding tube of finely woven synthetic fibre, referred to as "armouring." This reduces loss of active material to a minimum, at the same time having sufficient porosity to ensure good performance even at high rates of discharge. The negative plates, of normal rectangular pattern, are also armoured in this instance with microporous sheet material bonded together at the edges with p.v.c. strip. This gives a compact assembly having no loose separators. Features mentioned recommend the use of this battery for road traction vehicles and fork-lift trucks. *Crompton Parkinson Ltd., Crompton Hse, Aldwych, W.C.2.*



Crompton Parkinson's new high-capacity accumulator

ELECTRICAL INSTRUMENT INNOVATIONS

AMONG standard types of instrument for electrical measurements appearing recently on the market, several new ideas have been incorporated. Most striking of these is an original concept in moving-coil instrument design introduced by Crompton Parkinson in their latest version of 3 in. bench-type voltmeter ammeter. This makes use of a fixed magnetised core within the moving-coil to provide the necessary air-gap flux, the usual external permanent magnet and pole-piece assembly being replaced by an annular ring of sintered soft-iron powder. The principle has been made practicable by making use of the latest techniques in powder metallurgy, whereby soft-iron powder has been fused with permanent magnet powder alloy in a sintering process to form the central cylindrical magnet. The new form of construction confers greater robustness and reliability than the normal type, while giving equal movement sensitivity. The instruments mentioned are intended for school instruction purposes, but there is no doubt that the magnet system employed will be extended to industrial-type instruments in the near future.

In a more specialised field, the usual methods of complex waveform analysis can involve quite a laborious process. A new harmonic analyser, designed to facilitate such measurements, enables a number of selected harmonics to be displayed simultaneously over a continuous period. The instrument has been developed by the Telephone Manufacturing Co. for detection of interference to telecommunications circuits from 50 c/s traction and distribution cables and lines. It will give simultaneous measurements of up to 12 odd harmonics from 50 c/s to 1,550 c/s, these being registered on separate meters, each having a range of 0-100 mV. One of the great advantages of the instrument is that it is possible to make a photographic record of harmonic relationships at any particular instant.

Pulse frequency measurement, up to 1·1 Mc/s, is the main function of the "TSA 3336" instrument, recently introduced by Venner Electronics Ltd. It can also be used for pulse counting or for providing measured time intervals in microsecs or larger units. The instrument may be reset remotely or locally by manual or automatic means and can be supplied with provision for feeding outputs to a line printer or reperforator for data logging. The unit is transistorised, suitable for mains or battery operation and has overall dimensions 14½ in. by 12¼ in. by 8½ in. It costs £338.

Of two new instruments of continental origin imported by Aveley Electric, one is a portable multi-range meter, the other, in a rather different category, is a precision variable capacitance assembly, providing standards for laboratory bridge measurements. The first, the Gossen "Type UPH1," reasonably priced at £34, is an extremely versatile instrument which not only measures voltage and current in the ranges 12-600 V and 60 mA to 120 A at 40 c/s to 4 kc/s, but also covers the measurement of frequency, resistance, power factor, phase angle and reactive power. It has a high quality movement with spring-loaded jewelled bearings and incorporates a 1·5 V cell for resistance measurements.

The second apparatus referred to, consists of a system of plug-in air-dielectric precision capacitor units giving a series of capacitances from 10 pF to 10 μF in increments of 10 pF. Each capacitor is calibrated to ±0·1% of 1 pF and has a stability claimed to be of the order of 0·05%/annum. Calibration test certificates are supplied with each standard.

Crompton Parkinson Ltd., Crompton Hse, Aldwych, W.C.2.

Telephone Manufacturing Co. Ltd., Hollingsworth Wks, Martell Rd, S.E.21.

Venner Electronics Ltd., Kingston by-pass, New Malden, Surrey.

Aveley Electric Ltd., Ayron Rd, Aveley Industrial Est, South Ockendon, Essex.

High sensitivity with ample gap clearances is ensured in this Crompton instructional meter by a sintered magnet construction

This frequency and time measuring instrument by Venner has an attractive appearance and is suitable for mains or battery operation

Accuracies of ±1½% are claimed for each scale of this multi-range meter by Gossen, measuring a.c. voltage and current, power factor resistance and frequency

TRADE PUBLICATIONS

SELLOTAPE.—13-page booklet entitled "Electrical Taping" describes the properties of a number of new base films and adhesives for the electrical industry. Gordon and Gotch (Sellotape) Ltd., 8-10 Paul St, E.C.2.

WANDSWORTH.—New 79-page electrical accessories catalogue with illustrations and price-lists. References W.10 and W.100, respectively. The Wandsworth Electrical Manufacturing Co., Portman Chmbrs, 7-9 Baker St, W.1.

INTERNATIONAL RECTIFIER.—Bulletin number SR2007, an information sheet giving technical details of Medium Power Silicon Stacks with industrial price list. International Rectifier Co. (Great Britain) Ltd., Hurst Green, Oxted, Surrey.

SANTON.—Price list Immersion heaters, thermostats, control units, central heating units, flanges, accessories, hairdressers' equipment and thermal storage water heaters. Pamphlet S11.61 describing special tap and water controls for electric water heaters; "Hot-tap," "San-tap." Santon Ltd., Somerton Wks, Newport, Monmouthshire.

CRYPTON.—20-page brochure No. DL209, describing Engine Testing and Tune-up equipment. Crypton Equipment Ltd., Bridgwater, Somerset.

AURI-NEWS.—News Bulletin for December, 1960. Vol. V, No. 8. Includes announcement of Sarkes Tarzial Magnetic Recording Tape. Ad. Auriema Inc., 85 Broad St, New York, N.Y., U.S.A.

A.E.W.—Eight-page brochure describing a few standard range of electric furnaces and ovens by A.E.W. Ltd. (Incorporating Watmel Ltd.), Imperial Wks, High St, Edgware, Middx.

FIRST AID.—12-page booklet entitled "First Aid Regulations" which details all latest first aid regulations with full descriptions of appropriate outfits. Cuxon, Gerrard and Co., Oldbury, Birmingham.

ASCOT.—Ten-page catalogue of lamps: general lighting service, coloured, special and fluorescent, with complete price list, RE 37470, revised Jan., 1961. Ascot Lamps and Lighting Ltd., Arcola St, E.8.

L.B.—Brochure entitled "In An Emergency," which describes Blackstone mains failure standby plant installations in hospitals. Output tables are given, seven generators illustrated. R. A. Lister and Co. Ltd. and Blackstone and Co. Ltd., Dursley, Glos.

SPIRE.—New Spire Speed nut manual. Includes all recent developments in range of spring steel fastenings. Pictorial index gives additions to ranges of weld nuts, push-on fixes for rectangular studs, etc. 84 pages in all, profusely illustrated with tables of weight per 1,000 of each line and inches-decimal-millimeters conversion tables. Simmonds Aerocessories Ltd., Buryon Hse, 789 St. James's St, St. James's, S.W.1.

News of the Week

Share of Swiss Market Dwindles

Germans oust U.K. refrigerators

PRICE is the big broom which West German electric-appliance manufacturers are using to sweep their British competitors from the Swiss market. Not only are the German appliances 5% to 10% cheaper, but their designs are more to Swiss tastes than those of British goods. With no shelter, not even EFTA in view of Switzerland's low tariffs, some British firms are giving up without a struggle.

Refrigerators are a case in point, a market currently running at about £8·3 million a year. Two-thirds of Swiss imports are now coming from Germany and a mere 3½% from UK; yet it is only five years since Britain was supplying 20% of the import market. A Board of Trade observer says one of the difficulties here is that the internal dimensions of the British refrigerator are not suitable for Swiss containers. And with Swiss makers specialising on small absorption-type refrigerators, the Germans are concentrating on larger types.

Next in importance come washing machines, with imports at the rate of £2 million a year. Here the picture is brighter, even though there are 25 Swiss makes. Two UK firms have been doing well with washers of under 100 kgs, but there has been little success with larger machines where, once again, it is the West Germans who lead the import field. West Germany provides about three-quarters of the imports and the UK most of the remainder. There is a good market for small machines in individual flats and for larger "communal" machines housed in the basements. Preference is for fully automatic machines with heaters. Quality rather than price is decisive. Machines with vitreous enamel drums are unwanted.

Vacuum cleaners provide a good opportunity, with imports around the £½ million mark, of which British makers supplied about 17% in 1959. Swiss production is unimportant. Sweden was the most important supplier in 1959, followed by Holland, W. Germany and the UK. The stand-up type with dust-bag seems to be gaining in popularity and there is a demand for the smaller broom-stick type.

Electricity is available throughout Switzerland, even in the most remote mountain village and the Swiss housewife prefers it to gas; except for central heating, where oil is mainly used, it is the main source of fuel and power. Annual consumption is over 1,000 kWh/head. There are no import quotas or restrictions on hire purchase.

M.I. VENTURE IN JAMAICA

IN a move to extend activities of Metal Industries Ltd. to the West Indies, its subsidiary company, Dynamo and Motor Repairs Ltd., is joining with Kingston Industrial Works Ltd., of Kingston, Jamaica, in the formation of a new company, KIW Dynamo Motors Ltd. This concern is to undertake the rewinding and repair of motors and other electrical plant in Jamaica and the other islands in the West Indies and also act as selling agents for the Metal Industries' group in that territory. It is being formed primarily with an eye to good business resulting from the forthcoming electricity supply changeover in Jamaica from 40 cycles to 50 cycles, which is expected to take 2½ years.

Kingston Industrial Works Ltd. is an old-established firm involved mainly with the manufacture and installation of machinery for sugar plantations. Two years ago it formed a subsidiary, KIW (Electrical) Ltd., which now claims to be the largest electrical contractors in the island.

ACQUISITION

THE Newcastle upon Tyne electrical contracting firm, Veale-Nixon Ltd. is to be acquired by T. Clarke and Co. Ltd. The latter have agreed to purchase all the 10,000 £1 shares by an exchange of 200,000 Ordinary 2s Clarke's shares. It is understood that service agreements have been entered into with Mr J. H. Nixon (senior) and Mr N. Veale as joint managing directors, and Mr J. H. Nixon (junior) as supervising engineer.

Electricians' Dispute at Berkeley

ON their dispute over the stopping of the 5s a day site allowance being referred to top officials of the ETU and NFEA, some 500 electricians employed by N. G. Bailey and Co. Ltd., at Berkeley nuclear station site, returned to work last week. They had been on strike for more than two weeks, claiming that with the allowance stopped they had gained nothing from the 1s an hour pay rise (as we reported on 19 Jan.).

Prison and Fines in U.S. Anti-Trust Case

FINES totalling £120,000 were imposed on American electrical companies and their officials, and seven executives were each sentenced to 30 days' imprisonment by a Philadelphia court on Monday in the biggest anti-trust case ever. Nor is this all, for on the first day of sentencing only six of the 20 charges were dealt with, and the firms are liable for damages to customers who can prove over-charging. The Government had alleged price-fixing and rigging of bids for turbines, transformers and switchgear, and Judge J. Cullen Ganey said the defendents had "flagrantly mocked the image of the nation's free enterprise system." The case involves 32 American corporations.

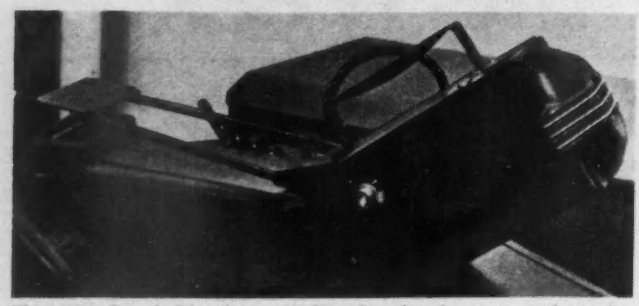
Three of the officials to receive gaol sentences were from the American General Electric Co., two from Westinhouse and one each from Cutler-Hammer and Clark Controller; all received heavy fines as well. Judge Ganey said he was convinced that many executives had been "torn between conscience and an approved corporate policy." General Electric's fines for the day under various charges totalled about £64,600, and those of Westinghouse £57,100.

ANOTHER STEAM POWER STATION FOR SOUTHAMPTON WATER?

HAVING postponed plans for a possible nuclear power station at Hamstead, IoW (ELECTRICAL TIMES, 22 December), the CEGB are now considering erecting a conventional power station on Southampton Water in order to meet the growing demand for electricity in Southern England. The CEGB have told the New Forest Rural District Council that the particular locality in which they are immediately interested is the area between Calshot Spit and Fawley oil refinery, where a detailed examination of the potentialities of such a site is now being undertaken. Trial borings on the land were carried out several years ago and further borings might not be necessary the Board state, but discussions about particular aspects will be held with the various authorities concerned. It seems that the New Forest RDC had earlier decided to oppose a proposal for modifications to the County Council's proposals for the Hampshire coast green belt, and the RDC have told the CEGB that they are objecting to the exclusion of the particular area from the green belt and to any possible industrial development thereon.

The location of the site under consideration strengthens the view that it might be an oil-fired station.

ANOTHER FIRE-LIGHTER



This new electric fire-lighter, evolved by the Carron Co., has been shown at the new Portobello showroom of the South of Scotland Electricity Board. The device is slipped under the grate, and in about 2½ minutes the heat from the element makes the fuel glow. Then it switches off, to leave a blast of hot air to take over, we understand. It is claimed to make a steady fire in five minutes. A safety feature turns off the heater if the device is pulled from under the fire while still switched on. We understand that Carron's device is still a prototype, and not yet on the market

Two Crane/o.h. Line Accidents—£62,000 Damages

A TOTAL of £62,000 damages was recently awarded to three men seriously injured in two accidents involving crane jibs which touched overhead power lines in Northern Ireland. £18,000 damages against the Electricity Board for Northern Ireland and £9,000 against his employers, Farrans Ltd., were awarded in the Ulster High Court to Mr T. J. Mulgrew who lost an arm and received severe injuries to his feet. Agreed damages of similar amounts were also awarded to Mr W. B. O'Neill, a fitter, who lost both legs, an arm and the thumb of the remaining hand in the same accident as Mulgrew. They were removing the jib of a mobile crane last May when it touched the Board's h.t. line.

For Farrans, the men's employers, Mr E. W. Jones, Q.C., referred to two previous accidents involving h.t. lines when there was talk of removing the system from Farran's property. He submitted that the Electricity Board should indemnify his clients for the accident or at least pay a very substantial portion of the claim.

A director of Farrans, Mr R. Watson, said they had met a representative of the Board in 1955 to discuss the question. Farrans wanted sufficient height to enable their machinery to operate safely underneath the wires. After August, 1955, one of the poles carrying the lines was increased in height.

A Board engineering assistant, Mr J. Fleming, referred to a meeting with Mr Wilson, plant manager, after an accident in 1953, concerning increasing the clearance. Mr Wilson spoke of a 50 ft clearance, but this could only be made by the insertion of an additional pole, which the firm did not wish because it would be another obstruction. Mr Fleming agreed that the Board had a duty to warn persons about the use of machinery in close proximity to h.t. wires.

In a similar accident at Coolkeeragh industrial site, Londonderry, in April, 1959, a labourer, Mr W. Fahy, lost two toes of his right foot and his right hand was made almost useless, being held permanently in the clawed position. He was awarded £8,000 agreed damages against Clarke, Chapman and Co., owners of the crane and Charles Brand and Son, his employers at the time.

Sizewell Line Route Agreed?

MAYBE the CEGB transmission line experts are keeping their fingers crossed, but East Suffolk Parish Council's Executive Committee have accepted a revised route for overhead lines in connection with Sizewell nuclear power station! And a 400 kV system is to be adopted, as we reported on 26 January. The new route will not pass over any villages, farms or cottages and will run from Sizewell, north of Blaxhall, south of Wickham Market, crossing the A12 at Pettistree, continuing north of Burgh, cutting the Ipswich borough boundary in two places in the Whitton area, then on to a new substation at Bramford and then away into West Suffolk to a point north of Hadleigh.

The County Planning Officer, Mr T. B. Oxenbury, explained that although the paralleling with the existing line will not take place in East Suffolk, the re-routing is necessary in order that the line can reach the point near Hadleigh. He thought the revised route was the better one. It would pass over open country nearly all the way and when it neared Ipswich it was closer to existing lines and passed over areas whose amenity value was "almost nil."

Amalgamation

TWO firms in the Expert Tool Group —Sharp Control Gear Ltd. and Electran Coil Co. Ltd.—are being merged into one concern under the title of Expert Industrial Controls Ltd. Both companies already occupy a 25-acre site at Ashby-de-la-Zouch, Leicestershire, and for the past three years have had the same management. There has been overlap in their sales and production organisations and the amalgamation is a logical step to eliminate such complications. Mr A. Murray is chairman of the new concern, with Mr B. S. Worrall as managing director.

OFFICIAL PUBLICATIONS

National Parks Commission. Annual report. HMSO. 6s (see page 225).

BS 2818. Auxiliaries for Operation of Fluorescent Lamps. Part 2. Capacitors. 6s.

Further Education for Those in Industry and Commerce. FBI. 6s.

SODIUM LAMPS IN SHORT SUPPLY?

SODIUM discharge lamps for street lighting were alleged to be in short supply by Mr C. Grey, M.P. for Durham, when questioning the President of the Board of Trade in the House of Commons last week. He suggested that short of supply "was due to concentration of the lamp manufacturing industry," and asked for reference of the industry to the Monopolies Commission.

Extending his allegations, Mr Grey suggested that the Hetton (nr Skipton, Yorks) UDC was "finding it extremely difficult to obtain sodium discharge lamps," and said he was informed that other local authorities were having similar difficulties. The difficulty was aggravated by the fact that lamps which had been supplied were not living up to their guaranteed lives. The President of the Board of Trade undertook to investigate any specific evidence supplied to him.

R.P.M. INQUIRY PROGRESS

PROGRESS with the Board of Trade's inquiry into resale price maintenance practice was touched on by the President of the BoT in answer to Parliamentary questions last week. He said that in addition to questionnaires sent to British organisations, information had been obtained from Canada and the USA, and inquiries had been made in Sweden. He would not make a firm statement on whether the summary of the results of the inquiry, which was regarded as confidential, would be published. He told questioners that the inquiry had not been completed.

WYLFA INQUIRY SOUGHT

ALTHOUGH objecting to the proposal to build a nuclear power station at Wylfa Head, Anglesey, the Council for the Preservation of Rural Wales agreed last week to ask the Minister of Power to order a public inquiry into the scheme in order that consequential matters can be clarified. Mr J. D. K. Lloyd, the secretary, said: "We don't want pylons striding across Snowdonia," and it seems that the Council wants a full examination of the route of proposed transmission lines.

The Council is also seeking a firm statement from the CEGB as to whether Wylfa Head is in fact an alternative to Edern, an area on the preservation of which they hold strong views.

RAILWAY WORK—FIRMS' VIEW

WELCOMING the Government's green light on the London Midland railway electrification scheme (reported last week), manufacturers and contractors are confident that the plan can be completed by 1966—the technical, manufacturing and constructional resources are available to achieve that target.

But in a joint statement BEAMA and the Locomotive and Allied Manufacturers' Association of Gt. Britain stress that the industry is disturbed that despite several months' consideration the Government is still unable to give a clear indication of policy regarding the modernisation programme as a whole.

There is still no authorised capital investment beyond 1961, for which the authorised expenditure is already committed by existing orders.

By its very nature, railway equipment production has to be planned well ahead and the manufacturers urge the Government to give early authorisation to the further modernisation proposals.

N. Eastern Board raise Tariffs

IN tariff revisions announced by the North Eastern Electricity Board, operative from 31 March, the number of primary units charged at 6d under the domestic two-block tariff is increased from 11 to 13 and the final rate is raised from 1d to 1·15d/unit. For the average domestic consumer it is estimated that the increase amounts to about 7d/week. Along with some increases the opportunity is also being taken to simplify commercial tariffs. Thus, the three-block rate (now available for up to 30 kW), has the first 13 units per quarter/100 W of lighting charged at 6d and the next 52 units/100 W lighting at 3d, but the final rate is reduced from 1½d to 1¼d. There are similar changes in an alternative tariff, but the flat rate for late shop-window lighting has been withdrawn.

For industrial consumers the m.d. tariffs have unchanged kW demand rates, but the unit charges are increased from 0·67d, 0·62d, 0·545d and 0·51d to 0·78d, 0·655d, 0·58d and 0·53d, respectively, for l.v. supplies and from 0·64d, 0·59d, 0·515d and 0·48d to 0·75d, 0·625d, 0·55d and 0·50d, respectively.

In the farm three-block tariff, the fixed charge is unchanged, but the initial number of units chargeable at 6d is increased from 165 to 195 for up to 10 kW, with increases for additional loads, and the final rate rises from 1d to 1·15d/unit.

But to stimulate off-peak storage heating the Board is reducing the present rates by 0·05d to 0·7d and 0·8d, respectively.

Announcing these changes, the Board point out that the new bulk supply tariff and other increased costs will raise the Board's total costs by about £1·3 million in the year commencing 1 April next, virtually extinguishing the anticipated surplus by existing tariffs. In addition, the Board have to find capital for expanding and strengthening its system.

M.E.M. at Holyhead

THE new £80,000 factory of the Midland Electric Manufacturing Co. Ltd. at Holyhead, Anglesey, was officially inaugurated by Mr N. Macpherson, Parliamentary Secretary to the Board of Trade, last week. At the ceremony Mr W. J. Barber, chairman, said the Board of Trade's policy of dispersal of large units had forced his company to look elsewhere for expansion. Although somewhat disagreeable to the company at the time, he was now sure that the policy was the right one.

Rapid Ring Main Installation

ERECTION of a 33 kV ring main unit alongside a busy railway track in under 24 hours is South Wales Switchgear's latest achievement of rapid installation under difficult circumstances. Part of the SWS contract for 32 switchgear substations for the Eastern Region electrification, BR, this unit had to be installed at Shadwell and, owing to its size and location, had to be erected during the week-end slack period. Each section of the switchboard was erected as it was off-loaded, starting with the main framework and, later, the superstructure framework, all connections, alignment and checking being completed in 18¼ hours, ready for commissioning tests and main cable jointing to the British Railways' power system.

Erection work proceeding early on Sunday morning beside the railway track at Shadwell

ELECTRICITY IN NATIONAL PARKS

CONFLICT of interests is commonplace between electricity supply authorities and the National Parks Commission, which is responsible for "extensive tracts of countryside designated for their natural beauty and the opportunities they afford for open-air recreation." This is reflected in the eleventh annual report covering the year ended 30 September last, published by HMSO last week.

The outstanding question discussed is that of undergrounding. The National Parks Commission argues that Section 37 of the 1957 Electricity Act, which obliges electricity boards to take account of the effect their schemes may have on the natural beauty of the countryside, justifies boards incurring unremunerative expenditure. Quoted in support of this is a speech made by Lord Mills when he was Minister of Power.

Although the commission takes note of a Government claim that all officers of electricity boards are alive to the provisions of Section 37, they express "a feeling that in some cases their appreciation of its implications could well be improved."

Cases of dispute are quoted with reference to the South Western EB, South Wales EB and the North Western EB. In contrast, appreciation is expressed for the attitude of the CEGB and the Commission explicitly recognise the difficulties of placing the bulk transmission lines underground.

FLOOR-WARMING SHOWROOM

A SPECIAL demonstration room to show floor and ceiling heating using their embedded electric cables has been opened at the Frederick Rd, Salford, works of Volex Electrical Products Ltd. Examples of building materials, thermal insulation, cable design, installation and control are included in the display which may be visited by our readers, preferably by appointment.

Nuclear Competitive Tendering to Stay

COMPETITIVE tendering for contracts to supply and build nuclear generating stations, often attacked as an uneconomically expensive procedure, is to stay. This was made clear by Ministry of Power parliamentary secretary J. C. George during a House of Commons debate last Friday. He called the reliance on competition "a normal sound business precaution."

Mr J. Eden, M.P., objecting to the present system, had suggested that the average cost of preparing a tender was £150,000, for which in the long run the purchasers would have to pay. He pointed out as well that a waste of manpower was involved. But Mr George based his reply on the fall in costs achieved with successive stations designs: in terms of price per kW, Berkeley, £160; Bradwell, £159; Hinckley Point, £133; Trawsfynydd, £123; Dungeness, £110.

Mr George defended the one station per year arrangement put forward by the 1960 White Paper as sufficient to "sustain an industry of size and efficiency capable of competing with success abroad." The Government believed that with five or six stations under construction at any one time, the industry could obtain the information needed to ensure technical development.

Replying to criticism that the UKAEA did little about small and medium-power reactor development, Mr George said it did not seem possible to construct a small nuclear station at anything like an economic price. Even in the USA and Canada, serious difficulties were recognised. The Government felt that there was a future for small nuclear power stations at home and abroad, but that the time for this had not arrived. However, said Mr George, "having got a lead in the bigger aspect of power stations we will not neglect the possibility of getting a lead with the small ones."

PROTECTING THE PURCHASER

GUARANTEES in respect of equipment and appliances which contain clauses depriving the consumer of his rights at law are the subject of a campaign by the Consumer Advisory Council. The Council urges purchasers to delete from guarantees any clauses which release the producer from liability in the event of accidents caused by faulty manufacture. Electric fires are quoted as an example of goods where shoddy production is likely to create accident risk and, in fact, a well-known firm has accepted such an alteration of their guarantee by a customer. The eighteenth edition of the Council's journal, *Shoppers' Guide*, records one case of an automobile manufacturer who also accepted modifications to their warranty made by a prospective customer along the lines suggested by the Council.

In addition to outlining the effects of retail price maintenance, this latest edition reviews small electric water heaters by nine manufacturers and tabulates essential statistics.

NEW ELLIOTT SUBSIDIARY

JOINTLY with the Rotron Controls Corporation of Woodstock, New York, Elliott Brothers (London) Ltd. have formed a new subsidiary, Rotron Controls Ltd., in which Elliott's have a two-thirds controlling interest. Operating from headquarters at the Elliott-Automation factory at Rochester, Kent, the new concern will manufacture flowmeters and associated equipment for sales throughout Europe, the Middle East and the British Commonwealth (except Canada).

ELECTRICAL FIRMS JOIN SPACE PROJECT

SOME of the largest firms in the electrical industry are prominent amongst eight companies which have formed a new organisation, British Space Development Co., aimed at providing industry with an organisation that can negotiate with the British Government, other countries and foreign industrial organisations on matters concerned with the commercial use of space. The eight companies are Associated Electrical Industries, Associated Television, British Insulated Callender's Cables, Decca Radar, de Havilland, Pye, the Rank Organisation and Rolls-Royce.

In speaking of the hopes of the company in London last week, Sir Robert Renwick said that besides providing the Government with an indication of British industry's faith in space research, it would show its readiness to play its part and take its share of the risks as well as its share of the future benefits that might arise.

It seems probable that initial engineering activities of the company will be in the telecommunications field.

Rheostatic-Black link-up

JOINT marketing arrangements in certain applications have now been arranged between the Rheostatic Co. Ltd. and Black Automatic Controls Ltd., both members of the Elliott-Automation group. Rheostatic will sell Black solenoid-operated valves, pressure and flow switches to the heating, ventilating and air-conditioning industries under the name "Black-Satchwell" alongside its own range of controls. In future, also, Rheostatic will, as appropriate, include "Black-Satchwell" controls when offering comprehensive control systems for these industries and to manufacturers of gas- and oil-fired boilers.

Black Automatic Controls Ltd. have just opened a sales office in London at Steel Hse, Tothill St, S.W.1.

Export Packing Aid

One of the "Hygro-Robot" automatic air dehumidifiers installed at Lep's Chiswick Packing Depôt, for export packaging of electronic and scientific equipment

500 ft TOWER FOR CENTRAL LONDON

A NEW landmark for central London will be a 500 ft radio and observation tower if present GPO plans materialise. For some time the Post Office has been faced with the problem of obstruction, by new high buildings going up, to their TV and microwave telephone links which are situated on the roof of the Museum exchange in Howland St, W.1. In connection with the building of a four-storey extension to the exchange, it has been proposed to erect a 507 ft tower, 50 ft in diameter, to house the necessary equipment and, at the top, the beam aerials for both TV and telecommunication links. As an added facility, an observation platform 463 ft from the ground will be open to the public at a small fee and will be reached by two high-speed lifts.

The radio links will interconnect the studios, control centres and transmitters of the broadcasting authorities, but will not provide direct transmission to the public. On the trunk telecommunication services, the micro-wave links will, it is estimated, meet all foreseeable needs for the next 40 years.

The scheme, which has the approval of the Royal Fine Arts Commission and the LCC, is estimated to cost £1¼ million, including the exchange extension. Construction is expected to start later this year.

BLADE FAILURE RESEARCH

RESEARCH into cost of steam turbine blade failure will be facilitated by special equipment which the CEGB has undertaken to purchase from Bristol Aircraft Limited. A contract announced last week provides for CEGB purchase of specially engineered vibration test equipment and the hire of associated telemetry and other data-processing equipment.

A difficulty about investigating turbine-blade vibration is the near-impossibility of simulating full-load operating conditions outside a complete turbine. Electronic equipment supplied under the contract will enable data to be obtained while the turbine is operating on load. A test equipment capsule will be installed in the shaft of the turbine, in the central bore and the output from transducers mounted on turbine blades will be fed into the capsule for transmission via slip-rings (in frequency-modulated form) to stationary measuring equipment.

Basically, the electronic equipment to be supplied to the CEGB is a refined and developed version of equipment originally designed for the Bloodhound guided weapons test programmes. However, to permit installation inside the turbine shaft an extended use of transistors has been introduced.

Will railways build electric trains?

QUESTIONED about powers for the new railway boards to produce their own motive power units, the Minister of Transport said last week that ownership of existing railway workshops would pass to the proposed British Railways Board and statutory power to manufacture would be included in the forthcoming legislation. He declined to comment on accusations that the British Transport Commission was being supplied by outside industry with "inferior motive power units," and he emphasised the importance of export trade in this connection. It will be up to the British Railways Board to decide how railway workshops should be used.

Improved street lighting

LIGHTING conditions on all trunk roads and Class 1 roads are the subject of a survey which is almost completed, the Minister of Transport told the House of Commons last week. The results of the survey will have to be studied before any major steps to further street lighting standardisation is considered.

The Minister was answering a question which suggested that a substantially lower accident rate was secured with better lighted roads. He did not directly endorse this view, but said he realised that the increase in accidents at night was proportionately greater than what had occurred in accidents during the day. However, street lighting on any length of road had to be considered in relation to that road's characteristics, so a narrower standard in lighting was not possible.

Later, Mr Marples told another questioner that no advantage was found in using yellow head lamps instead of white. Drivers with experience in France sometimes thought they were less dazzling for oncoming traffic than white ones, but head lamps on French cars were generally of lower intensity than those on British cars. This was the reason for lack of dazzle, not the difference in colour.

12 months non-stop at Calder Hall

LAST week one of Calder Hall's four nuclear reactors was shut down for routine maintenance and change of fuel for the first time in 12 months. The reactor operated continuously from 2 Feb., 1960, to 31 Jan., 1961, and during that period electricity generation was at full load rating for 95·6% of the time. No shut-down due to fuel element failure was necessary.

Analysis of the relatively small amount of time work at less than full load produced the following table:

Experimental work	2·5%
Scheduled maintenance of ancillary equipment	0·7%
Unscheduled blower maintenance	0·6%
Unscheduled maintenance of other equipment	0·4%
Special tests on fuel elements	0·2%
Total ...	4·4%

I.E.E. centre's jubilee

THE largest of the provincial centres of the IEE, the South Midland Centre, with a membership of 3,850, is to hold a three-day meeting from 20 June to 22 June next, to mark its diamond jubilee. It is proposed that one day shall be spent in each sub-centre with visits to nearby works and the final day at the main centre, terminating with a dinner-dance in Birmingham in the evening.

FREEDOM OF CHOICE PAYS

OF over 8,000 new houses built by the Aberdeen Corporation since they adopted a "freedom of choice" cooker policy ten years ago, 5,000 have an electric cooker, and this in a community long wedded to gas. In fact the changeover to electric cooking was slow at first, but persistently good salesmanship by the North of Scotland Hydro-Electric Board, coupled with the conviction that electricity is both the cheapest and best, soon broke the opposition and last year some 80% of the Aberdeen Council tenants in new houses chose electric cookers. The installation of the 5,000th electric cooker there was marked by a brief ceremony recently when Lord Provost J. Stephen presented an electric refrigerator to the consumer concerned.

Inquiry on Brighton substation site

SEEKING a central site in Brighton for a substation, the South Eastern Electricity Board have obtained a compulsory purchase order for a corner of Clifton Terrace gardens, which is locally regarded as one of the most attractive Regency parts. But local residents who objected put forward their views at a public inquiry recently after Mr P. S. Watson, Brighton and Hove district manager for Seeboard, had explained that the substation was necessary to change over to a.c. 400 homes in the Clifton Terrace area. The site would be excavated to 4 ft below ground level and would not be more than 6½ ft above ground. It would be surrounded by a fence and concealing shrubbery. One of the objectors, Mr W. Teeling, MP for Brighton's Pavilion Division, maintained that it was one of the most lovely terraces in the town, completely different from anything else, but another resident of 30 years, Mr E. J. Peerless, said they had waited ten years for an a.c. supply and it was essential to have it.

The inquiry was held by Mr A. H. F. Linton, deputy chief engineering inspector, Ministry of Power.

The new Birmingham branch premises of Courtney Pope (Electrical) Ltd. at Nechells Hse, Dartmouth St, where a wide range of lighting fittings is available for immediate sale. The branch is under the direction of J. Hall, area manager

Radioactive waste from Berkeley

THE recent publicity on the discharge of radioactive waste into the air and into the Severn from the Berkeley nuclear station has not worried East Dean Rural District Council, it seems. After considering a report and recommendation from their Health Committee they decided to raise no objection to the proposals. The report referred to the CEGB's application for authorisation to allow them to make the discharges and to the views of two Ministers concerned in the matter.

The Minister of Agriculture is satisfied that even in the most unfavourable circumstances the concentration of radioactivity in any fish will not exceed the maximum permissible level considered safe for human consumption. The Minister of Housing is satisfied that the discharges will not give rise to any public health hazard or cause hazard to anyone using the estuary and beaches for fishing, bathing and other recreational activities.

Fridge Sales on Ice!

DELIVERIES of British-made domestic refrigerators to the home market during December totalled 34,354—some 29% lower than in the corresponding month of 1959. That reduction is 10% better than the previous month's figure, however. Throughout 1960, deliveries of British refrigerators to the home market reached a total of 924,362, compared with 849,362—an increase of 9·4%.

Exports, however, were much better last year. December deliveries to overseas markets amounted to 10,453—a 37·7% increase on December, 1959, and for the whole year exports rose by 42·2% to a total of 136,574.

Sayings OF THE WEEK

"Obligations under the 1957 Act enjoined all three [CEGB, Electricity Council and the Minister] to preserve natural beauty, to conserve fauna and flora and to preserve places of historic interest. Those responsibilities have been discharged with good taste, good manners and great care." . . . MR J. C. GEORGE, Parliamentary Secretary to the Minister of Power, in debate on nuclear power.

"I would be almost afraid to operate one of these machines in case it turned round and told me off." . . . ALDERMAN G. B. BOUGHTON, Lord Mayor of Birmingham, speaking of electronically controlled machine tools at the IEE South Midlands Centre dinner.

"I don't think the increase in wages is necessarily going to increase the costs of electrical installations." . . . MR C. R. WATERHOUSE, national president, at Bristol branch of Electrical Contractors' Association dinner.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, February 7

	£ per ton	Weekly change £
COPPER, standard class A (settlement)	221½	+1½
" (3 months)	223½	+2½
LEAD, refined pig, 99·97% purity (cash)	65	+¼
" (3 months)	66	+¼
TIN, refined, min. 99·75% purity (settlement)	788	+4
(3 months)	790	+2½
ALUMINIUM, ingots 99·99·5%	186	—
" wire bars (4×4×54")	193½	—
BRASS Strip 63/37	195½	+3
SILVER (Troy oz)	79⅜d	—

	£ per ton	Weekly change £
ZINC, virgin, min. 98% purity (cash)	81	+1½
" (3 months)	80½	+1
RUBBER, per lb.		
No. 1, RSS, spot	23⅞d	—
c.i.f. basis, ports, April	23½d	−⅛d
ARMOURING:		
Galv. Steel Wire (0·104 in.)	68	—
Mild Steel Tape (0·04 in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	69	—
AMERICAN PRICES:		
Copper, electrolytic (per lb)	29c	—
Lead, (New York)	11c	—

* *Tape Price, now an average, includes varnishing*

Sir Hamish champions engineers' status

CONCERN as to the status of engineers was expressed by Sir Hamish MacLaren at last Friday's Jubilee year dinner held by the South Midland Centre of the IEE. Such status, he said, was not at all commensurate with services rendered to the community by the engineering profession. Sir Hamish was responding to a toast to the "Institution of Electrical Engineers" proposed by the Lord Mayor of Birmingham, who had paid tribute to the Institution in preserving the high professional standards necessary to maintain scientific and technological progress today. The Lord Mayor had also said that the patience and skill of electrical engineers had brought inestimable benefits to mankind. After reviewing the activities of the South Midland Centre in his speech, Sir Hamish went on to say how grateful he was for the sterling work carried out by local centre committees in furthering the interests and vigorous growth of the IEE. Referring to the notable expansion of the electrical engineering field in recent years, he said that the Institution were struggling to bring the various sections into line with present-day needs. In this context, he said that although the present field and scope of electrical engineering was indeed wide, he was convinced that all phases were interlinked and that he was not in favour of further fragmentation. At the same time, he was anxious that close and friendly relations be maintained with kindred institutions.

A final toast to "Guests and Kindred Associations" was proposed by Brig F. Jones, chairman of the Centre.

Lakeland Inquiry on 14 Feb.

DEPRIVED of an electricity supply because of protests about amenities, the people of Borrowdale, in the Lake District, are planning to give full support to the North Western Electricity Board at the public inquiry at Rosthwaite on 14 Feb. The Board voluntarily placed the line underground when a supply was given to Grange in 1956 and extended to part of Rosthwaite in 1958. But they contend that extension of the line entirely underground to the head of the valley would be unjustifiably expensive.

L.E.B's Transformer Orders

FOUR firms have each been awarded an order by the London Electricity Board for the supply of 240 500 kVA, 11 kV/433 V distribution transformers. The AEI share in these orders we noted last week and we now understand that similar orders have been placed with Ferranti Ltd., Crompton Parkinson Ltd. and Fuller Electric Ltd.

News in Brief

Lord McCorquodale of Newton, Lord Coleraine and Sir Hamish MacLaren are to be guest speakers at the ASEE annual dinner at Grosvenor Hse, on 7 April.

A technical committee studying tenders for a nuclear propulsion unit for a 65,000 ton ship has nearly concluded its work and will shortly draw up its report (Ministry of Transport in the House of Commons last week).

President of the Board of Trade, the Rt Hon F. J. Erroll, is to open the Electrical Engineers' Exhibition at Earls Court on 21 March.

We are asked to make it clear that the title of the new London headquarters building of the English Electric Co. in London is English Electric Hse, not Nelson Hse as we stated on 19 Jan.

An Apprentice Training Exhibition was held at the AEI Rugby works from 30 Jan. to 3 Feb.

Annual festival dinner of the Royal Commercial Travellers' Schools is to be held at the Savoy Hotel on 7 April.

Mitchell Construction Co. have been awarded a contract worth £33,000 for the construction of a 1,500 ton ash-dust bunker at Richborough power station.

A new headquarters for the Durham section of the Transmission Dept. of the North Eastern and Yorkshire Region of the CEGB was officially opened at Pity Me by Mr P. Briggs, Regional Director, recently.

Company Activities

GLOOM certainly had no place on the London Stock Exchange last week. President Kennedy's pledge to maintain the present value of the dollar and his stated determination to foster higher economic growth within a framework of sound fiscal policies and relative price stability sent the Dow Jones industrial share index soaring to its highest level on Wall Street since around the middle of last June. True, London did not likewise soar but this buoyant transatlantic sentiment none the less imparted extra solidity to our own firm market which was further encouraged by the forecast given by the National Institute of Economic and Social Research that the UK national output will rise by 2½% in 1961 and industrial production by 4%.

For the most part, electrical shares against this background were no more than firm but one or two outstanding share movements brought the section under closer scrutiny. The £1 Ordinary shares of the Electric Construction Co., for example, which set out the week at 31s 6d, came in for persistent buying on a market short of stock and were consequently sparked up to close the week at 37s after 38s 3d. Since 1949 its gross trading profit has moved somewhat erratically, from £351,500 to a peak £610,000 in 1957 and then back to £312,800 for the year ended 31 March, 1960. Further, the last 9% dividend was covered no more than 1·8 times by earnings. The sudden strength of the shares is therefore something of a puzzle and can hardly be connected with a greater realisation of November's announcement that the outstanding 5¼% convertible loan stock will be redeemed on 1 March, 1961, since already most holders of the stock have elected to swap into Ordinary shares which will have to be serviced with at least a 9% dividend.

An easier explanation can be found for the rise from 59s to a peak 65s 6d in the Ordinary shares of Colvern. Favourable comment in a broker's circular pointed out that the company exhibits characteristics which could produce rapid growth and this was later bolstered by the attention drawn by Mr L. Hinton to the fact that exports by the British electronic industry are now five times what they were ten years ago. After such a rapid rise in so short a time, however, it was inevitable that profit taking should clip the shares back to 63s 9d—but still a gain of 4s 9d over the week.

In a week when the takeover headlines mainly involved newspapers and property companies there was also room in the market for more whispers of a takeover deal where EMI was expected to bid for Decca. This rumour was in turn exploded by both companies but even so EMI, which now takes in Morphy-Richards, saw its 10s Ordinary shares, 1s 3d a time up on the week, at 44s, and Decca's 10s Ordinary spun up from 55s 3d to 57s 7½d and the 10s "A" Ordinary gained 1s 6d over the week at 54s 9d.

No excitement was occasioned in share prices by the get-together to form the new joint organisation, the British Space Development Co., despite Sir Robert Renwick's promise of a future El Dorado. Among the first eight member companies are AEI, Associated Television, BICC, Decca, Pye and the Rank Organisation. The other two are Rolls-Royce and de Havilland. Of the first six companies, only ATV "A" and Rank shares put on 3d apiece following the news to 31s 1½d and 25s, respectively, although over the week ATV stood 2s higher and Rank's shares were 1s 9d dearer.

For all of this lack of immediate share-price response however, investors might be well advised to watch this Space!—*From our City Correspondent.*

M. L. Alkan Ltd.

Records both in turnover and net profit are reported by this electroplating equipment concern for the year ended 30 Sept. last. Trading profit is £136,064 (*£76,609*), and the net profit after tax, £53,032 (*£27,324*). Total dividend is raised 7½% to 22½% with a final of 15%. Initial orders for conveyorised equipments have been received and this new development is proceeding in a satisfactory manner, Mr M. L. Alkan, chairman and managing director, reports. There has been no reduction in demand for the company's products and service in the first few months of the current year, but in existing conditions he suggests it would not be prudent to approach the current year's prospects otherwise than with cautious optimism.

Cable and Wireless (Holding) Ltd.

In addition to increased earnings, further scrip and rights issues are announced. There is to be a one-for-five scrip issue and the rights issue is to be on a one-for-ten basis at 10s/share. For 1960 the group net earnings total £1,022,000, compared with £847,376 for the previous year, after taxation charge of £693,000 (*£594,026*). The final dividend is 1¼d/unit. The directors are satisfied that in the absence of unforeseen circumstances, results for 1961 should provide adequate cover for continuation this year of the 10% dividend rate. To enable stockowners to participate to a greater extent in the company's holding in Cables Investment Trust, the directors have written up the book value of that holding by £4,665,000 to £6 million and they propose to recommend capitalisation of part of the surplus to provide for the above scrip issue.

Goblin (BVC) Ltd.

For the substantial drop in profits for the past year the directors blame the credit restrictions imposed in the 1960 Budget. Before then the company was operating at an increased turnover, they state. Similar restrictions have also applied to Canada with the result that the figures for the group profit have been adversely affected.

Year to 30 Sept.	£ Trading Profit	£ Net Profit*	% on Ord.		Ord. Price	
			Earned	Paid	High	Low
1956	94,624	614	—	10	8/9	5/9
1957	104,065	6,874	1	10	8/6	3/9
1958	200,956	48,311	13	7½†	4/11	2/2
1959	328,529	116,135	30	12½	13/3	4/6
1960	212,762	38,812	9	10	14/3	5/7

* Available for parent company.
† Plus 100% capital bonus.

Muirhead and Co. Ltd.

At the end of December last, the value of unexecuted orders was 35% up on a year earlier, and the value of orders received in the first quarter of the current financial year was substantially higher than in the corresponding period last year, Mr J. V. Foll, the chairman, reports. Furthermore, many new instruments now under development will go into production during this year and next, he adds.

E. Shipton and Co. (Holdings)

There is no dividend for the 18 months ended 30 Sept. last, but an interim of 10% in respect of the current year is declared "as a mark of confidence." Reporting a group loss of £35,045 for the period, compared with a profit of £36,276 for the previous year, Sir Leslie Nicholls, the chairman, states that the directors are satisfied that the telephone rentals and sales will show an appreciable increase during the current year.

Herman Smith Ltd.

After providing for estimated losses of £80,000 in connection with oil heaters, the group profit for the year ended 30 June last dropped to £53,233 (*£136,492*). After tax, net profit is £26,092 (*£68,166*) and dividend is maintained at 25%.

Sterling Electric Holdings

A heavy fall in sales of machine guns and oil heaters contributed substantially to the loss sustained in the past year, and the position was aggravated by overproduction of certain items, Mr P. A. Bligh, the chairman, reports. A complete reorganisation has been initiated. The directors anticipate a small loss for the 13-month period ending 30 April next, but there are reasonable prospects of more satisfactory results thereafter. Among new items to be produced this year is an electric central-heating system for houses and flats.

Dividend Declared

Electrical Components (Holdings). Interim 4% (*same*).

OVERSEAS NEWS

from our correspondents abroad

CANADA

Trans-Canada Grid Plans

Proposals for a trans-Canada grid linking the provincial systems are said to be under consideration by Federal officials. It is reported from Ottawa that the Federal Government may initiate system studies to decide whether d.c. or a.c. should be used for the links and how the scheme would be paid for and operated.

BC Expenditure in 1961

This year, BC Electric estimate they will spend $53 million on improving the system and bringing power to customers on the Lower Mainland and southern Vancouver Island. Work should be completed on the construction or expansion of 13 substations and the biggest single expenditure will be $13·3 million on the Burrard generating station under construction near Port Moody. The station is to have six 211,000 h.p. generators, the first scheduled for commissioning in early 1962. Transmission and distribution circuits planned cover 243 miles.

Dryerettes?

Do-it-yourself dry cleaning machines are now being prepared for the Canadian market. Companies interested include Philco, John Inglis, Moffats and RCA Victor. Coin-operated machines, some of them entirely automatic, are reported to dry clean articles at about a quarter of the cost of conventional dry cleaning. Most manufacturers seem inclined to distribute the machines to established dry cleaners, at least until the market is established. Machines have been under development in the US and Europe for three years and have cleaning time cycles varying from 27 minutes to 47 minutes. This month both Moffats with Norge equipment and McClary Easy with an Italian model are expected to start distribution. Ald Canada will handle the Westinghouse design.

More Farm Electric Power

Greater use of electricity by farmers is being pushed by Ontario Hydro and other producers. Ontario Hydro estimate that the average farmers' monthly consumption will have risen from the 1959 figure of 477 kWh to 870 kWh by 1965. Farmers are already making wide use of electric pumping for cow-to-tank-to-truck milk transfer and both infra-red lamps and soil heating cables for rearing pigs and poultry are gaining in popularity. Materials handling is as yet in the early stages and examples of future developments include automatic silo unloaders, stable cleaners and automatic feeders for poultry and pigs.

Subway to Go Ahead

Approval for the Montreal subway, costing between $270 million and $300 million, was given by the Government recently. The 14·7-mile subway will run east along Ontario street and it is expected to take about four years to build.

MALTA

Maltese Development

Industrial development planned for Malta was outlined in the House of Commons last week. The Under Secretary of State for the Colonies said that it included a start this year on a power station to provide an additional 17·5 MW firm capacity for 1964-65. This is in addition to power station extensions completed in 1960, which doubled firm capacity to 20 MW. Also included in current plans is provision of a distillation plant producing 1,000,000 gallons of drinking water daily from sea water. This is scheduled for commission by 1964-65. Amongst industrial projects which have qualified for grants is one for the production of gold-bonded diodes.

AFRICA

Sudan Electrical Prospects

In the Sudan, the economic position is good and development projects and industrialisation are increasing, according to a report published in the Export Service Bulletin recently. The population exceeds 11,000,000, but only 300,000 live in the four largest towns and it is little more than this number who are able to make use of electricity. However, several housing projects are scheduled, a hydro-electric power station is under construction at Sennar and two further stations are planned. The report, dealing with electric lamps, insulated cables and wires and electrical accessories, says that all these items can be imported under an open general licence. The Sudan has no standard specifications and British Standards are normally used. British goods are well known, but foreign competition is stiffening, particularly in low-priced commodities. The report emphasises the importance of competitive pricing and the value of visits of representatives or of a good agent. At present the only firm manufacturing electrical equipment in the Sudan is producing a range of p.v.c. insulated cables.

Generating Plant for Mauretania

A contract valued at £460,000 for diesel-alternators and switchgear has been won by two companies in the Hawker Siddeley Group—Brush and Mirrlees, Bickerton and Day. The equipment is for a £50 million industrial development scheme in Mauretania, North West Africa, which includes an iron ore mine on the edge of the Sahara.

Nigerian Switchgear Contract

Switchgear for 11 substations in the city of Lagos will be manufactured by AEI. The contract is valued at £200,000 and covers equipment forming part of a new 33 kV distribution system.

Supply Nationalisation in Guinea

Nationalisation of public utility companies supplying electricity and water in Guinea was announced by the President Sekou Tourè, last week. "Intentionally poor performance" and failure to invest new capital were the reasons given for the move, but shareholders would be compensated, he said.

Cape Town Progress in 1959

In their sixty-fourth year of operation, 1959, the City of Cape Town undertaking connected their 100,000th consumer. Domestic consumers constituted 88% of the total and accounted for 60% of the annual unit consumption which, in 1959, was 796 million units, an increase of 5·2% on the previous year. Revenue during the year rose to £4·18 million and the surplus at the end of the year was £450,000. The revenue increase was in part due to a 5% surcharge on energy consumed, levied to relieve municipal rates and increase the surplus. The average cost of production per unit sold was 1·1352d. Firm generating capacity at the end of the year was 232·9 MVA and, during the year, the maximum load rose to 214 MW. It is anticipated that by the winter of this year Athlone power station will be in service and providing 90 MW of generating plant.

PAKISTAN

Shadiwal Hand-over

The Shadiwal hydro-electric project was officially handed over by the Canadian minister to the Pakistan authorities recently. This project is one of a number financed under the Colombo plan and constructed with Canadian aid. The two generating units in the station have a total capacity of 13·5 MW and operate under a head of about 20 ft. The annual output of the station is estimated at 76 million units and will be utilised for tubewells in the area. The Shadiwal station runs on tail water

from the Upper Jhelum canal and is connected by a 132 kV grid line to the Gujrat substation. At the station inauguration Mr Z. A. Bhutto, Minister for Fuel, said that the Government was considering transferring responsibility for local distribution from WAPDA to zonal public corporations. The Government has also asked WAPDA and the Karachi Supply Corporation to survey electricity demand in their areas during the next ten years. Welcoming the guests, Mr Ghulam Ishaq said that the project started in 1953, but could not progress until Canadian aid was made available. Canada had contributed $3·5 million of the total cost of $8·4 million to cover the entire foreign exchange and consultant charges.

Go Ahead for Rural Electrification

Clearance for schemes to connect 5,000 West Pakistan villages in ten years at a cost of Rs32·5 crores was given by the Central Development working party in Lahore to WAPDA in West Pakistan recently. Of the 16 water and power projects considered, clearance was given to three schemes costing Rs92·5 crores, but the Chara Dam project, estimated to cost Rs2·30 crores, was withdrawn. Consideration of 12 other projects was postponed.

Grid Section Energised

The 216-mile long, 132 kV double-circuit grid line linking Warsak to Kharian was energised for the first time recently. Constructed entirely by Pakistani engineers and using aluminium wire, this line is intended to aid power distribution to secondary centres in the northern regions of Pakistan.

INDIA

Not Enough Development Planned

Although allocation for power development under the third plan has been increased by Rs94 crores, the planning commission says there will still be a shortage of power in many parts of the country. The plan draft outline provided for Rs800 crores for power in the states and union territories, but these have now submitted a programme costing Rs938 crores providing for a target of 13·5 million kW instead of the six million kW suggested in the draft.

Russian Generators for Bhakra

Generators as well as turbines for the four 90 MW units at the Bhakra right bank power station may be supplied by the Soviet Union. The decision depends on successful conclusion of forthcoming trade and aid negotiations between India and the USSR. The existing left bank station has five units, the turbines for which were supplied by Japanese manufacturers while the generators were manufactured by AEI.

British Seek Durgapur Contracts

Representatives of three British firms are reported to be in New Delhi to examine progress on the new heavy engineering project at Durgapur and to discuss their participation in the supply of equipment for thermal power stations to be erected during the third plan period. The three firms concerned are Vickers Ltd. (London), Babcock and Wilcox and Vickers (India) Pvt. Ltd.

HONG KONG

30 MW Set Contract

As part of the equipment for the Hong Kong Electric Co.'s £0·9 million plan for its North Point B station, a fourth 30 MW turbo-generator has been ordered. The contract, valued at £¼ million, was awarded to English Electric and includes associated transformers and switchgear.

Electricity Firms' Plea Rejected

Last October the two Hong Kong electricity supply companies put forward alternative proposals to the compulsory acquisition of assets recommended by a Government-appointed commission. The Hong Kong Government has now rejected these proposals. The companies had proposed that the dividend should be 2·5 cents/unit of electricity sold and that a maximum margin for retention and reinvestment in the undertakings would be 2·2 cents/unit sold. The Government says that the companies have failed to answer the criticism that, although they raised capital for expansion almost entirely by charges on the consumer, benefits had gone to the shareholders and not the consumers. The commission did not regard the companies' proposals for integration as sufficient and a compromise solution is now being sought.

AUSTRALIA

Tumut Tunnel in Service

A nine-mile-long tunnel, drilled through rock, was commissioned recently as part of the Snowy Mountains scheme. The tunnel links the Tooma River to the Tumut pond dam from where the water will supply a number of hydro-electric stations.

Deputy PM to Visit UK

Expansion of the West Australian electricity networks in the far south west will form the subject of discussions between the West Australian Deputy Premier, Mr Watts, and British electrical contractors when he visits this country in March. He will also study educational methods with a view to establishing an institute of technology in Western Australia.

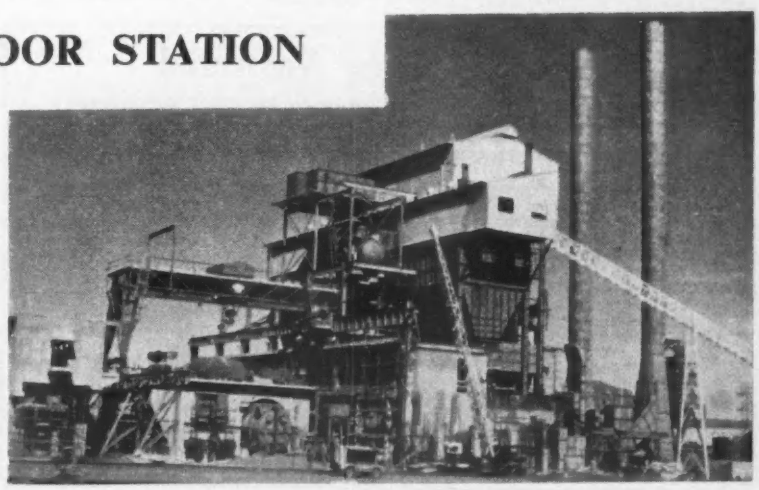
NEW ZEALAND

Wairakei Set Working Again

Output of the Wairakei geothermal power station is now 51 MW, following the recent recommissioning of a 13 MW generator unit. This generator broke down due to turbine blade fatigue in June of last year. A further increase in power output of 11 MW is anticipated when an experimental low-pressure turbine, now being installed, comes into service in September this year.

60 MW OUTDOOR STATION

Even the turbo-alternators are outdoors at this 60 MW station recently commissioned as part of the Mt. Isa Mines expansion programme in Australia. The units are weatherproofed and enclosures are provided only over the steam and exciter ends. Two GEC 30 MW single-stage turbo-alternators are supplied by two Babcock and Wilcox 280 klb/hr boilers, rated 900 lb/sq in., 850°F. The boilers burn opencut coal transported 800 miles from Scottville. Cooling water is brought 16 miles through steel conduit. British General Electric Pty, a subsidiary of GEC, were responsible for the £A5 million station. Most of the electrical plant was supplied by GEC



COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

10 Feb.—Neston U.D.C. Installation work in 82 houses.—Advertised 12 Jan. issue.

13 Feb.—Bristol C.C. (b) Electrical installation alterations, by contractors on N.I.C.E.I.C. roll, at Malvern Hse, Redland Training College, Elm La. Applications to City Architect, Council Hse, by above date. Alternative fixed-price tenders required.

13 Feb.—Kidderminster B.C. Electrical installations, 30 houses.—See 2 Feb. issue.

13 Feb.—Luton B.C. Rewiring 24 houses, Dellcott Close. Borough Architect, Town Hall.

13 Feb.—Newcastle upon Tyne C.C. Repair and maintenance of (2) electric lighting in 29,530 dwellings over period. Housing Manager, 19-21 Dean St.

13 Feb.—Stoke-on-Trent T.C. (a) Electrical installations by approved contractors in 52 dwellings, Longton Hall Rd, Longton. Applications to City Architect, Kingsway, by above date. Deposit £2.

13 Feb.—Sunderland C.B.C. Electrical installations in 260 dwellings, Town End Farm Estate.—Advertised 26 Jan. issue.

14 Feb.—Barnsley C.B.C. Supply: concrete columns, public lighting tungsten, mercury vapour and sodium lamps.—Advertised 26 Jan. issue.

14 Feb.—Hemel Hempstead B.C. Electrical installations: (a) 15 dwellings, Wheelers La; and (b) 15 dwellings, Wood Cres.—See 2 Feb. issue.

15 Feb.—Barnstaple B.C. (b) Electrical work in house improvements, Fair View. Borough Surveyor, The Castle.

15 Feb.—Durham C.C. Subcontracts (b) electrical installations in Denton C.E. (Cont.) School, additions and adaptations; Frosterley South County School, Jarrow Dunn St new County School, Peterlee Eden Hall County School, additions; Rookhope County School, alterations, etc.; Wearhead County School, alterations, etc. Applications to County Architect, South St, Durham, by above date.

15 Feb.—Keynsham U.D.C. Electrical installations for 11 shops and one supermarket at Bath Hill.—See 26 Jan. issue.

15 Feb.—Poole B.C. Supply of (Item 23) wiring supplies and accessories; (24) lamps; (25) batteries; (26) lanterns; (26a) time switches; (28) water heaters for year. Applications, enclosing, s.a.e., to Borough Engineer.

16 Feb.—Kincardine C.C. Electrical work in Laurencekirk Secondary School infants' dept. extension.—See 2 Feb. issue.

16 Feb.—King's Lynn B.C. Supply: lamps and sundries.—See 2 Feb. issue.

16 Feb.—Widnes B.C. Supply: equipment and lamps.—See 2 Feb. issue.

17 Feb.—Belfast C.C. Supplies list: items 22 to 39.—Advertised 26 Jan. issue.

17 Feb.—Belfast. (a) Electrical installation in additional classrooms, etc., at Royal Academy. Details from consulting engineers, McCandless and Marton, 6 Murray St, Belfast 1. Deposit £3 3s.

17 Feb.—Croydon C.B.C. Power socket installations in 720 houses, Mitcham Rd estate.—Advertised 2 Feb. issue.

17 Feb.—Deal B.C. Supply: lamps.—See 2 Feb. issue.

17 Feb.—Easington R.D.C. Supply: electrical goods.—See 2 Feb. issue.

18 Feb.—Coleraine and Portrush. Maintenance of: buildings and plant—electrical; radio installations and TV sets; and lifts.—See 2 Feb. issue.

18 Feb.—Halesowen B.C. Supply: lamps.—See 2 Feb. issue.

18 Feb.—Harlow U.D.C. Erection and wiring of 58 Group "A" concrete columns together with fitting lamps/lanterns on various roads. Engineer and Surveyor, A. W. R. Webb, Town Hall. Deposit £2 2s.

18 Feb.—Margate B.C. Supply of (List 5) lamps, fluorescent tubes, fittings and cables. Borough Engineer, 38 Grosvenor Place.

18 Feb.—Saltburn and Marske U.D.C. Electrical installations, 20 flats, Marine Parade, Saltburn. Surveyor.

20 Feb.—Bury C.B.C. Electrical installation, Seedfield County Secondary Modern School. Borough Engineer, Town Hall.

20 Feb.—Cardiff C.C. Supply: columns; lanterns and gear; time switches.—See 2 Feb. issue.

20 Feb.—Devizes B.C. Provision of bathrooms, electrical installations, etc., 1 to 12 Deramore Row. Borough Surveyor, Northgate Hse.

20 Feb.—Grimsby C.B.C. (c) Electrical installation in proposed Grange Primary Infants' School, Cambridge Rd.—See 2 Feb. issue.

20 Feb.—Litherland U.D.C. Annual list No. 7, tungsten and sodium lamps. Engineer and Surveyor: O. E. W. Street, Town Hall, Litherland, Liverpool 21.

20 Feb.—North Antrim Hospitals. Electrical maintenance for year. Secretary, Hospital Management Committee, Route Hospital, Ballymoney.

20 Feb.—Nottingham C.C. Two centrifugal pumps, motors, switchgear, etc., for Normanton-on-the-Wolds.—See 19 Jan. issue.

21 Feb.—Ilminster U.D.C. Supply and erection of 64 140 W sodium lamps along A303. Surveyor, N. J. Arney, Council Offices.

21 Feb.—Salford C.C. Supply: 15 ft concrete columns; 60 W sodium lanterns/equipment; (3) 100-150 W lanterns; (4) time switch/fuse boxes; (5) solar dial synchronous time switches.—See 26 Jan. issue.

21 Feb.—Tyrone C.C. (iii) Electrical installation in new technical institute at Dungannon.—See 12 Jan. issue.

21 Feb.—Wellington U.D.C. Supply: lamps, cable and fittings.—See 2 Feb. issue.

22 Feb.—North Down Hospitals. Supply of (Serial 5, item 2) lamps for year. Secretary, Hospital Management Committee, Ards Hospital, Newtownards.

22 Feb.—Stirling B.C. Electrical work in erection of 31 houses, St. John St/Academy Rd development.—See 2 Feb. issue.

22 Feb.—West Hartlepool C.B.C. Electrical system installation, High School for Girls. Details from architect, L. Auton, Regent Bldgs, York Rd.

23 Feb.—Ealing B.C. Electrical installation renewal at Drayton Infants' and Perivale Primary schools.—Advertised 26 Jan. issue.

23 Feb.—Isle of Axholme R.D.C. Sewage ejectors and sludge pump complete with motors, starter and accessories for West Butterwick scheme.—See 26 Jan. issue.

24 Feb.—Irlam U.D.C. Supply: lamps.—See 2 Feb. issue.

25 Feb.—Argyll C.C. Provision and erection of 56 15 ft steel or concrete columns with Class "B" lamps/lanterns/gear at Dunbeg Village.

25 Feb.—Coseley U.D.C. Supply of (List 3) electrical installation materials for 400 dwellings. Council Clerk, J. C. Roper, Council Hse.

25 Feb.—Leyland U.D.C. Supply: lamps.—See 2 Feb. issue.

27 Feb.—Golborne U.D.C. Supply: Class "B" concrete and c.i. columns, lanterns, sodium lamps and gear for 188 lighting units.—See 26 Jan. issue.

27 Feb.—Pocklington R.D.C. Contract 4. Supply and erection of 10,000 g.p.h. duplicate booster pumps complete with motors, starters and accessories at Market Weighton. Details from consulting engineers, John H. Haiste and Ptnrs, Belmont Hse, 20 Wood La, Headingley, Leeds. Deposit £3 3s, payable to R.D.C.

28 Feb.—Dewsbury B.C. Supply of concrete columns, 140 and 200 W sodium, 250 and 400 W m.v. lanterns, tungsten, sodium and m.v. lamps, swan-neck brackets and spigots, control gear, time-switches. Applications, enclosing s.a.e., to Lighting Engineer, 15-19 Victoria Rd, Springfield.—Advertised in this issue.

28 Feb.—Ossett B.C. Contract 2. Supply and erection of duplicate (each of 225 g.p.m. at 100 ft head) sewage pumping plant. Details from consulting engineers, A. Brooksbank and Son, 48 Sunbridge Rd, Bradford 1. Deposit £5 5s, made payable to Corpn.

2 March—Belfast C.C. Goods lift installation in Education Dept.—See 2 Feb. issue.

3 March—Belfast C.C. 33/6·6 kV step-down transformers.—Advertised 2 Feb. issue.

3 March.—Braintree and Bocking U.D.C. Electrical installation, by contractors on N.I.C.E.I.C. roll, in The Institute. Engineer and Surveyor, Town Hall, Braintree. Deposit £2 2s.—Advertised in this issue.

3 March.—Southport C.B.C. Electrical installation in Floral Hall, alterations and extensions. Borough Architect, 99/105 Lord St. Deposit £2 2s.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 115 queries answered this week

Sonic washing aids—makers of? L.R.R.—Northold Engineering Ltd., Elizabeth Wks, Thorney La, Iver, Bucks.

Landers, Frary and Clark, New Britain, Conn., U.S.A.—agents for? C.E.—L. G. Hawkins and Co. Ltd., 30-35 Drury La, W.C.2.

"Newtons of Taunton" battery chargers—address for spares? M.A.N.W.E.B.—Crypton Equipment Ltd., Bristol Rd, Bridgwater, Somerset.

"M.P.F." fluorescent lamp ballast units—makers of? S.F.D.—Smart and Brown (Engineers) Ltd., 8 Rose and Crown Yd, King St, S.W.1.

"Hovenden" hood type hair dryers—repairers of? S.E.B.—Osborne Garrett Ltd., 51-55 Frith St, W.1.

"Densacone" water heaters—address for spares? S.E.E.B.—Froylectric Ltd., Leamore St, Hammersmith, W.6.

"Hardy-Spicer" flexible couplings—makers of? K.E.C.—Hardy Spicer Ltd., Stratford Hse, Stratford Pl, W.1.

Window sill type air conditioners—makers of? T.E.—E.C.D. Ltd., Tonbridge, Kent; Temperature Ltd., Burlington Wks, Burlington Rd, S.W.6; Westool Ltd., St. Helens Auckland, Co. Durham; Tempair (Dorking) Ltd., Romney Wks, Romney Pl, Maidstone, Kent.

"Ergon" infra-red lamps—makers of? L.E.B.—Ergon Electrical Manufacturing Co. Ltd., Vulcan Rd, Bilston, Staffs.

4 March—Barrhead B.C. Rewiring of 292 pre-war houses, Arthurlee scheme. Burgh Surveyor.

6 March.—W. Riding C.C. Rewiring Shipley Grag Rd Junior School. Applications, quoting N.I.C.E.I.C. roll number, to Divisional Architect, Salisbury Bldgs, Albert Bldgs, Harrogate.

8 March—Bridge-Blean R.D.C. 60 g.p.m. at 64 ft head duplicate sewage pumps, etc., for Chislet scheme.—See 2 Feb. issue.

20 March—Nottingham C.C. Centrifugal well pumps, motors, switchgear, etc., for Basford. —See 2 Feb. issue.

21 March—Bedfordshire C.C. (b) Electrical installation in Clapham/Oakley County Secondary School.—See 19 Jan. issue.

No date stated.—Boston Group Hospitals. Applications invited for electrical routine maintenance work. Group Secretary, B. Haines, Sibsey Rd, Boston.

No date stated—Herts C.C. Applications invited for inclusion in list for electrical work—See 2 Feb. issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

15 Feb.—Canada. Wire and cable (28 items). Chairman, Committee on Utilities and Personnel, City Hall, Winnipeg 2. B.o.T. (ESB/3816/61).*

15 Feb.—India. Pumps for Trombay Atomic Energy Establishment. Purchase Division, Mohatta Bldg, Palton Rd, Bombay. B.o.T. (ESB/3770/61).*

18 Feb.—Greece. 6 and 12 V batteries and components. Supreme Supply Committee of the Ministry of National Defence, Athens. B.o.T. (ESB/868/61).*

20 Feb.—Pakistan. 12 items including motors, o/h crane, testing equipment and lathes. Director of Purchase, Water and Power Development Authority, Lahore. B.o.T. (ESB/3695/61).*

21 Feb.—America. Two autotransformers and one 69 kV voltage regulating transformer. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center, Denver 25, Col. B.o.T. (ESB/867/61).*

21 Feb.—India. Copper sheet, strip and earth plates. Director-General of Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (ESB/922/61).*

21 Feb.—New Zealand. 650 V pillar type link boxes. Town Clerk, Box 2199, Wellington C.1. B.o.T. (ESB/866/61).*

21 Feb.—S. Africa. 40 24 V 3 A charging rectifiers; 45 universal meters. Secretary, Union Tender Board, 291 Bosman St, P.O. Box 371, Pretoria. B.o.T. (ESB/859/860/61).*

22 Feb.—India. Induction heater. Purchase Division, Mohatta Bldg, Palton Rd, Bombay. B.o.T. (ESB/3769/61).*

23 Feb.—Argentina. One six-ton and one three-ton capstan and steering servo motor for vessel *Icudad de Buenos Aires*. Seccion Licitaciones y Compras, Flota Argentina de Navegacion Fluvial, Avenida Corrientes 389, Buenos Aires. B.o.T. (ESB/3768/61).*

24 Feb.—New Zealand. Bare and p.v.c. insulated copper conductors from 7/·052 to 37/·083, from 6,160 to 45,000 yd (nine items). Town Clerk, P.O. Box 5045, Dunedin. B.o.T. (ESB/864/61).*

24 Feb.—New Zealand. Paper insulated cable from 0·04 to 0·75 sq in., 1·1 to 6·6 kV, from 220 to 3,520 yd (nine items). Town Clerk, P.O. Box 5045, Dunedin. B.o.T. (ESB/865/61).*

24 Feb.—Germany 1,200, 3 x 40 W fluorescent fittings. Commanding Officer, U.S. Army Procurement Center, Frankfurt. B.o.T. (ESB/3799/61).*

24 Feb.—Rhodesia and Nyasaland. 7,200 torch batteries. Secretary, Federal Tender Board, P.O. Box 8075, Causeway, Salisbury. B.o.T. (ESB/3764/61).*

27 Feb.—S. Africa. 22 items: motors, starters, instruments and meters. Secretary, Union Tender Board, 291 Bosman St, Pretoria. B.o.T. (ESB/2789/61).*

27 Feb.—Sudan. 31 items: wire. General Manager, Central Electricity and Water Admin. (S.G.), Box 1380, Khartoum. B.o.T. (ESB/2782/61).*

28 Feb.—America. Three 600 V metal-clad station service switchgear sections. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center. B.o.T. (ESB/832/61).*

1 March—Rhodesia and Nyasaland. Six three-panel 11 kV, 250 MVA metal-clad switchboards and four similar extensible ring main units. Town Clerk, Bulawayo. B.o.T. (ESB/3005/61).*

3 March—New Zealand. 51 distribution transformers from 10 to 1,000 kVA (13 items). Town Clerk, P.O. Box 5045, Dunedin. B.o.T. (ESB/3014/61).*

6 March—India. Testing instruments and relays. Purchase Division, Mohatta Bldg, Palton Rd, Bombay. B.o.T. (ESB/3772/61).*

6 March—Sudan. One half-capacity furnace for melting white metal. Purchasing Agent, 3-5 Cleveland Row, S.W.1. B.o.T. (ESB/974/61).*

7 March—New Zealand. 450 mile telephone cable. Director-General (Stores Division), G.P.O., Wellington. B.o.T. (ESB/3822/61).*

8 March—Australia. Two 18 MVA 3-ph. outdoor transformers and 12 1 MVA indoor 3-ph. transformers. Secretary, S.E.C. of Victoria, 22-32 William St, Melbourne C.1. B.o.T. (ESB/2755/61).*

9 March—Australia. 20 66 kV, 1,500 MVA o.c.b's. Secretary, Western Australia Government Tender Board, 74 Murray St, Perth. B.o.T. (ESB/2737/61).*

13 March—Egypt. 2,550 metres copper cable. Purchases and Stores Dept., Railways Bldg, Shoubra Subway, Cairo. B.o.T. (ESB/2733/61).*

13 March—India. 230 kV single-circuit transmission lines lattice steel towers: (a) Kundah II to III Power Houses; (b) Kundah III to IV; (c) Kundah IV to Thudiyalur. 110 kV (d) Kundah V to Kundah I and (e) Thudiyalur to Erode. Chief Engineer for Electricity, 157 Mount Rd, Madras 2. B.o.T. (ESB/925/61).*

TRADE NOTES

Change of Address. The four marketing groups and the Advertising Department of the G.E.C. Osram Lamp Division have moved from Magnet Hse, Kingsway, to East La, Wembley. Telephone: Arnold 4321.

New Telephone No. The telephone number of Simms Motor Units Ltd. has been changed to Finchley 2692.

Licence. Marconi Wireless Telegraph Co. Ltd. have concluded an agreement with Itek Corpn. of Cambridge, Mass, U.S.A., to manufacture and market the Itek Electro-Products Co.'s range of Hermes crystal filters.

Final stages have been reached in negotiations between Wayne Kerr Laboratories Ltd. and Gertsch Products Inc., of Los Angeles, U.S.A., under which the former will handle a wide range of Gertsch electronic instruments in the U.K.

Amalgamation. The Conveyor Construction and Engineering Co. Ltd., of Eastbourne, has been incorporated in the Teleflex group of companies.

CONTRACTS PLACED

Birmingham Hospital Board. Electrical work in: Dudley Rd Hospital, ward C4, and Yardley Green Hospital, dispensary and pathological dept., Etna Lighting and Heating Co., £1,768 and £1,713; Selly Oak Hospital, F. Burton, £5,749; Powick Hospital system reorganisation, Abell and Smith's Electrical Co. Ltd., £21,049; Solihull Hospital, block A, F. Burton, £5,712; Burton-on-Trent General Hospital gynaecological dept., W. T. Parker Ltd., £3,301; Royal Hospital, Wolverhampton, ward modernisation, Atkins and Evans, £2,402, ring main distribution system, C. A. and W. J. Postings, £1,080; Women's Hospital, Wolverhampton, ward improvements, J. T. Jarvis Ltd., £1,672; Bromsgrove General Hospital X-ray dept. improvements, Whittaker Bros. Ltd., £1,193; Royal Salop Infirmary alterations, T. Wood and Son (Chester) Ltd., £1,337. Recommended.

British Transport Commission. Lighting installation, Red Barnes factory, Newcastle, James Scott and Co. Ltd.

Chilton P.C. Supply of street lighting equipment: 21 140 W sodium lamps/lanterns/brackets, A.E.I. Ltd.; ten tungsten lanterns/brackets, Group "B," Eleco.

Durham C.C. Electrical work in schools: Houghton-le-Spring R.C. Aided, Williams Bros. (Electrical) Ltd., £982 16s; Windlestone Hall Residential, drive lighting, J. Paterson and Co., £784; Fencehouses Modern, Hodgsons Ltd., £262; Ryhope Robert Richardson Grammar, N. of England Eng. and Electrical Co., £249 17s. Recommended.

Newcastle upon Tyne T.C. Electrical installations: Heaton Grammar and High School additions, Robson and Coleman Ltd., £1,982; Elswick Rd Secondary and Westgate Hill Secondary School additions, Williams Bros., £222 16s and £133 7s, respectively. Recommended.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Atcotrol. 792,674. Class 9. Electrical timers and instruments which control the operation of electrical circuits in accordance with a pre-selected time schedule, etc. Automatic Timing and Controls, Inc., Route 23, King of Prussia, State of Pennsylvania, U.S.A.

Audiophile. B797,252. Electrical sound-recording and sound reproducing apparatus, etc. R. J. Barton, 29b Randolph Cres, W.9.

Buneo, Bulon, Bunyl. 805,614, 5, 6. Class 9. Electric wires and electric cables, etc. Sterling Cable Co. Ltd., Sterling Wks, Aldermaston, Berks.

Copar. 812,215. Class 17. Material and parts for electrical insulation and electrical insulators, etc. A. Reyrolle and Co., Hebburn, Co. Durham.

Microstatic in design. 807,499. Class 9. Vacuum cleaners. The Kent Co. Inc., Canal and South James Streets, City of Rome, State of New York, U.S.A.

Poly-Lift. B805,899. Class 9. Switches and control apparatus, etc. R. Stahl, Maschinenfabrik, 231 - 239 Ulmerstrasse, Stuttgart-Wangen, Germany.

Powermatic. 803,857. Class 7. Washing machines and drying machines, etc. Bylock Electric Ltd., 109 South St, Enfield, Middx.

Protocoat. B803,531. Class 17. Insulating materials in liquid form. British Insulated Callender's Cables Ltd., Norfolk Hse, Norfolk St, W.C.2.

Pygmy. B799,400. Electrical connections, etc. The Bendix Corpn., 30 Rockefeller Plaza, New York 20, State of New York, U.S.A.

Theatrama. 809,098. Class 9. Electrical apparatus, etc. Michael Haslam Mills, Woodsheal, Whitmore Vale Rd, Hindhead, Surrey.

VW in design. B784,435. Class 11. Electric lamps and lighting fittings, etc. Vossloh-Werke Gesellschaft mit Beschrankler Haftung, Steinwerth 4, Werdohl-Westphalia, Germany.

BUSINESS PROSPECTS

Accrington. L. Frankland (Contractors) plan 64 houses and bungalows at The Laund.

Anglesey C.C. £203,000 stage 2 of David Hughes Secondary School planned and additions to Holyhead School, £148,541.

Bacup. Connolly Bros. (Builders), Haslingden Rd, Rossendale, Lancs, plan 20 houses.

Bedford B.C. Tender: Six-storey new municipal office block. Engineer.

Beds C.C. £¼ million selective school, stage one, planned. Architect.

Bexhill-on-Sea. Sawyer and Fisher, 81 Grosvenor Gdns Hse, S.W.1, quantity surveyors for 36 flats for County Developments Ltd.

Birkenhead. R. and J. Hughes (Builders), 89a Allport La, Bromborough, Ches, plan terrace of 11 houses and 12 houses, The Grange site, Shrewsbury Rd.

Blyth. Waring and Netts, 36 Jesmond Rd, Newcastle upon Tyne, architects for R. A. Gofton and Sons' Fountain Rd houses and shops.

Bolton. W. Pollitt and Co., Pool St, Bolton, plan 16 Thompson Rd houses.—Sutton Dwellings Trust, Victoria Hse, Southampton Row, W.C.1, plan 207 houses, 136 flats, 16 bungalows, block of shops and a communal hall on land off Wigan Rd.

Bootle B.C. Tender: 94 flats, etc., Strand Rd/Jersey St. Surveyor.

Bournemouth. Gregory Developments, Worthing, plan eight-storey block of 64 flats at Southbourne Rd.—Prowting Estates, High St, Ruislip, Middx, plan eight-storey block of 56 flats, Branksome Wood Rd.—J. A. V. Wraights, Winchester Hse, Firvale Rd, Bournemouth, plan three-storey block of 12 flats.—Gotch and Ptnrs, 26 Regency Sq, Brighton, plan 52 Grosvenor Sq flats.—Atlas Homes Ltd. plan seven-storey block of 25 flats at Grove Rd.—Park Investments, 98 Park La, W.1, plan blocks of 28 flats and 12 flats.

Brentford and Chiswick. J. R. Harris, 38 Queen Anne St, W.1, architect for 36 dwellings on Oxford Rd site.

Brighouse. Thornhill Yorkshire Estate Co., 1 Princes St, Huddersfield, plan Dewsbury Rd housing development.—Kirkburton Construction Co., 100 Northgate, Huddersfield, plan Close Lea, Rastrick, housing development.

Brighton. T. W. Newton-Dawson, Forbes and Tate, 44 Tottenham Court Rd, W.1, architects for 138 flats at London Rd.

Cambridge. J. Stanley Beard, Bennet and Wilkins, 101 Baker St, W.1, architects for Cambridge University Press' £1 million printing works.

Carlisle. A. S. Nixon, 83 Lowther St, plan 20 Green La houses.

Chelmsford. Moulsham Developments Ltd. plan 312 houses on Moulsham Lodge estate. Surveyors: W. Goodchild and Co., 123 South St, Romford.—Cooper Estates, Wilmington Hse, Wilmington, Dartford, plan 108 houses, Beechenlea estate.

Cheltenham. Span Developments, 18 Dryden Court, Parkleyes, Ham, Kingston, plan 22 flats, Connellmore, Old Bath Rd.

Chesterfield. F. Clifton, 11 Rockingham St, Sheffield 1, plan 51 Peverill Rd houses.

Chorley B.C. Tender: 56 dwellings, Princess St. Engineer.

Consett. A. Watson, Front St. Whickham, plan 32 houses at Bridge Hill Farm.

Coventry. Dolphin Development Co., Dolphin Sq, S.W.1, plan 81 flats at Allesley Hall Drive, Allesley Park estate.

Dewsbury. G. Grotherick (Leeds) Ltd. plan 35 Frank La dwellings.

Doncaster T.C. New maternity and child welfare clinic planned, Chequer Rd. Surveyor.

Eastbourne. New Ideal Homesteads Ltd., Mead Hse, South St, Epsom, Surrey, to develop land west of Stanmer Drive.

Enfield B.C. Tender: 24 flats and 26 houses, Hoe La. Engineer and Surveyor.

Epping U.D.C. Tender: 16 flats and 12 houses, Centre Drive. Clerk.

Gillingham B.C. Tender: 12 dwellings on Brompton Group F redevelopment area, Wood St. Engineer.

Glasgow. Lawrence Building Co., 137 West Regent St, Glasgow C.2, plan 56 Prospecthill Rd houses.

Gosforth. A. Craigie and Sons, 20 West Rd, Newcastle, plan a six-storey block of 24 flats at The Grove.—Pascal J. Stienlet and Son, Queen Sq, Newcastle, architects for R.C. Primary and Secondary Schools.

Hailsham. Brighton and District Property Trust plan 112 houses, etc., at Pevensey Bay.

Hambledon R.D.C. Tender: Four bungalows, Clappers Meadows, Alfold. Engineer.

Harlow New Town. O. E. Parratt, Adelaide Hse, London Bridge, E.C.4, quantity surveyors for £100,000 laboratory and offices at Temple Fields for Revertex Ltd.

Harmondsworth. B. C. Coffin, 25 Victoria St, S.W.1, quantity surveyors for Penguin Books' proposed extensions.

Hastings. B. Stevens and Ptnrs, 49 Havelock Rd, Hastings, architects for 18 dwellings and five-storey block of flats, Brookwood, Sedlescombe Rd.

Hendon B.C. Tender: Branch public library, Childs Hill, N.W.2. Engineer and Surveyor.

Ilford. Hilbery Chaplin and Co., 135 South St, Romford, plan 36 flats at Redbridge La East.—B.C. Tender: New infants' assembly hall and extensions to junior hall at Garies School. Engineer.

Kingston upon Thames. George Wimpey and Co., The Broadway, Hammersmith, W.6, promoters of scheme for three eight-storey blocks of flats, Albany Park Rd.

Leamington Spa. A. Blackburn, Stone Hse, Willenhall, Warwickshire, plan 44 flats at Avenue Rd.

Liverpool. Planning Committee considering application for redevelopment of Queen Sq/St. John's La/Roe St site by erection of 16-storey building with shops, restaurant and 130 flats.—T.C. Tender: 91 Storrington Ave dwellings. Architect.

London. T. P. H. Braddock, 14 Gt. Smith St, S.W.1, architects for factory and offices at East Dulwich Rd, S.E.22.—Hilton, Wright and Ingham, 11 Campden Hill Rd, W.8, architects for National Spastics Society's laboratory accommodation at King's Head Yd, S.E.1.—Westmore and Ptnrs, 121 Cheapside, E.C.2, architects for factory at Wyke Rd, E.3.—Adams, Holden and Pearson, 38 Gordon Sq, W.C.1, architects for £¼ million Commonwealth Hall of Residence at Cartwright Gdns, Bloomsbury, for University of London.—Oscar Garry and Ptnrs, 66 Gloucester Pl, W.1, architects for ten-storey extension to Decca Hse, Albert Embankment, S.E.—T. P. Bennett and Son, 43 Bloomsbury Sq, W.C.1, architects for L.T.E. Wood La office building.—Ellis Clarke and Gallannaugh, 37 Soho Sq, W.1, architects for six-storey office building at Gresham St, E.C.2.—R. Seifert and Ptnrs, Red Lion Sq, W.C.1, architects for Wood St, E.C.2, office block with shops.—Chamberlin Powell and Son, 15 Avenue Studios, Sydney Mews, S.W.3, architects for redevelopment of North Barbican area.

Luton. Howell and Brooks, 4 Queen Victoria St, E.C.4, architects for £¼ million six-storey block of shops and offices on site of the Cresta Ballroom for Norwich Union Insurance Societies.—7-11 Taylor St site to be leased to Harvey Smith (Luton), Brache Bldgs, Aton Rd.—Ronald Lyon (Estates) Ltd., Lyon Rd, Hersham, Walton-on-Thames, Surrey, plan single-storey factory fronted by double-storey office block at Craddock Rd.

Maidstone B.C. Tender: New central library, Faith St. Clerk.

Manchester. Regional Hospital Board plans £87,500 extensions to Christie Hospital's laboratory.

Newcastle. Spence and Price, 26 St. Mary's Pl, architects for £150,000 extensions to Kenton Secondary School.

Portslade. Westway Properties, Goldstone Villas, Hove, plan 40 bungalows at Mile Oak Rd.

Rotherham. Following planned: £36,000 hostel at Kimberworth High St; £35,000 mental health hostel at Park Lea; £30,000 Kimberworth health centre; £32,000 adaptation and re-equipping of new Whitehall restaurant of College St.

Rugby. W. A. Blackburn, Stone Hse, Willenhall, Coventry, plan 24 flats, three storeys high.

St. Albans T.C. Tender: 16 old people's flatlets, Mount Pleasant. Engineer.

Sheffield. Hospital Board plans alterations to Whittington Hall Hospital, Chesterfield, new wing for about 500 patients.—Alan Pennington, Collegiate Cres, architect for 15-storey flats with two satellite blocks of four storeys in Hangingwater Rd; cost £400,000.

Shrewsbury. Fletcher Estates (Harlescott), 6a and 8a Mount Pleasant Rd, prepared scheme for 800 houses in ten-year scheme.

Skegness U.D.C. £60,000 improvements to Council's Embassy ballroom planned.

Southampton B.C. Tender: Contract B344: 136 flats in five-storey blocks at Maybush Triangle. Engineer.

Spennymoor. N.C.B. Divisional Architects' Dept., Team Valley Trading Estate, Gateshead, prepared plans for new headquarters of offices for No. 4 Area of the Durham Divisional Coal Board, to cover 40,000 sq ft.

Stafford. Birmingham Regional Hospital Board to approve scheme for H.T. substation and renewal of electricity distribution system at Staffordshire General Infirmary: cost £16,000.

Stamford T.C. Museum, etc., proposed as extensions to High St library. Surveyor

Stevenage. Farmer and Dark, Romney Hse, S.W.1, architects for £1 million plus factory for Fibre Container Division of Bowater Paper Corporation.

Stockton-on-Tees. Marsh Ltd., Grangefield Rd, Stockton, plan 80 houses, Halstone, and 114 houses, Bishopton Rd West.

Stretford. Charteris Estate plan redevelopment of their King St properties. Agents, S. H. Chippindale and Co, Howard Hse, Bank St, Bradford 1.

Sutton Coldfield. Bernard Sunley Investment Trust, 25 Berkeley Sq, W.1, plan 36 flats in three blocks at Lichfield Rd.

Swinton. Lanes Construction Co. (Manchester), 4 Campbell Rd, Winton, Manchester, plan Worsley Rd housing development.

Teddington. W. S. Hattrell and Ptnrs, Hanover Hse, Hanover Sq, W.1, architects for Iris Productions Ltd. £280,000 television studios at Broom Rd.

Torquay. Bernard Sunley Ltd., 25 Berkeley Sq, W.1, plan 114 flats in 13- and eight-storey blocks at Hotel Villa Como site, etc.—Dr R. G. D. Forward, of 33 Barton Rd, plans nine-storey block of 72 flats.—M. L. Walton, Middle Lincombe Rd, plans 30 flats in five-storey block at Rozel.

Tynemouth. Cussins (Contractors), The Drive, Gosford, plan ten-storey flats on East St.

Wakefield T.C. Tender: 27 flats in three blocks at Pinfold La. Engineer.

Wallsend-on-Tyne. Bernard Thorpe and Ptnrs, 10 Market St, Newcastle, submitted proposals for redevelopment of central area of the town.—S. W. Milburn and Ptnrs, 9 Esplanade, Sunderland, architects for George Angus and Co's factory additions on the Coast Rd.

Warrington. W. R. Walker, Liverpool, plan houses development at Station Rd, Penketh.

Warwick B.C. Tender: Six shops, offices and stores in two blocks and six maisonnettes and two flats over garages in two blocks. Engineer and Surveyor.

Business Prospects—continued

Watford. Rice Bros., Hempstead Rd, Watford, plan 20 houses, 26 bungalows, 42 flats at Leavesden.

West Bromwich. George Wimpey and Co., Hammersmith Gro, W.6, plan new housing estate at Grove Vale.

Whitburn. Sir Hedworth Williamson, Bart., 19 John St, Sunderland, plans 112 houses, five houses and four shops with flats on land at South Bents estate.

Woking. A. J. Wait and Co., Wellington Cres, New Malden, Surrey, plan 275 houses at Manor Farm site.

Wokingham. J. T. Cook and Son, 37 London St, Reading, plan 101 houses, Southlake estate.—P. H. Smith (Reading), 125 Highgrove St, plan 187 houses and shops and residential development near Church Rd.—H. A. Coff, Colmans Moor La, plan 150 houses.—Blakes (Beenham) Ltd., Bath Rd, Padworth, Reading, plan 85 houses, Blagrove La.

Worthing. Kenneth Parker and Assoc., 9 Hythe St, Dartford, Kent, architects for £¼ million scheme for 100 dwellings at Findon Farm estate.—L. H. Fewster and Gamble, 5 Liverpool Gdns, Worthing, plan 41 flats at Heene Rd.—F. Trower, 43 Teville Rd, architects for Loxwood Developments' four-storey and three-storey blocks totalling 34 flats.—A. J. Ickeringhill, 40a Easton Pl, Brighton, architect for five-storey block of 32 flats and three blocks of three houses and one pair.—Gregory Housing Ltd., Farncombe Rd, Worthing, plan five-storey block of 14 flats.—Kenneth Parker and Assoc., 9 Hythe St, Dartford, Kent, architects for six-storey block of 12 flats, two blocks of six flats at Tarring.

York. Developments (Northern) Ltd., York, plan 74 houses, North La.—F. B. Frisby, Park Gro, York, plans 22 Hamilton Gdns bungalows.

GAZETTE ANNOUNCEMENTS

COMPANIES ACTS

Icemaster Ltd. Mr R. P. Booth, 5 Rumford Pl, Liverpool 3, appointed liquidator at extraordinary general meeting on 23 Jan. for the purpose of voluntarily winding-up.

Glenhose Ltd. Mr J. S. Meyler, 2 Marlborough Pl, Brighton 1, appointed liquidator at extraordinary general meeting on 17 Jan. for the purpose of voluntarily winding-up.

Holmes Electrical Ltd. Mr P. Cardwell, 93 Queen St, Sheffield 1, appointed liquidator at extraordinary general meeting on 18 Jan. for the purpose of voluntarily winding-up.

R.B. Tapes Co. Ltd. Mr K. R. Cork, 19 Eastcheap, E.C.3, appointed liquidator at extraordinary general meeting on 16 Jan. for the purpose of voluntarily winding-up.

B. Pearson Products (Electrical) Ltd. Winding-up order dated 23 Jan.

Bracrealm Electrical Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 13 Feb. Persons intending to appear to notify Cochrane and Cripwell, 119 Finsbury Pavement, E.C.2, by 1 p.m., 11 Feb.

G.B.H. Distributors (Stoke-on-Trent) Ltd. Mr P. J. Snow, 17 Albion St, Hanley, appointed liquidator at extraordinary general meeting on 26 Jan. for the purpose of voluntarily winding-up.

John Newth Ltd. Mr A. T. Thomas, Monument Hse, Southend, Ledbury, appointed liquidator at extraordinary general meeting on 24 Jan. for the purpose of voluntarily winding-up.

Colclough (Hanley) Ltd. Mr P. J. Snow, 17 Albion St, Hanley, appointed liquidator at extraordinary general meeting on 26 Jan. for the purpose of voluntarily winding-up.

Electroservice (R. W. Taylor) Ltd. First meetings of creditors and contributories to be held at Room 401, Inveresk Hse, 346 Strand, W.C.2, on 10 Feb., at 3.30 and 4 p.m., respectively.

Mayfair Electric Ltd. First meetings of creditors and contributories to be held at Room 401, Inveresk Hse, 346 Strand, W.C.2, on 10 Feb., at 2.30 and 3 p.m., respectively.

Ideal Homes Electric (Lancs) Ltd. Meeting of creditors to be held at Kingsley Hotel, Bloomsbury Way, W.C.1, on 17 Feb., at 9.30 a.m.

BANKRUPTCY ACTS

Receiving Orders

Leicester. K. Perkins, radio, electrical and television retailer, carrying on business as K.P. County Electrics at 60-62 rear Leicester Rd, Oadby. Receiving order dated 25 Jan.

High Court of Justice. F. J. Debens, appliance dealer, of 19 Mount Pleasant Villas, N.4. Receiving order dated 31 Jan.

High Court of Justice. V. C. Jones, electrical goods dealer, carrying on business as Victa-Vision Radio and Television, of 40 Hornsey Rd, N.7. Receiving order dated 27 Jan.

Public Examinations

Croydon. E. N. Folkard, electrical dealer, of 183 Lee High Rd, S.E.13. Public examination: 11 a.m., 16 March, at County Court, Scarbrook Rd, Croydon.

Pontypridd and Ystradyfodwg. W. I. King, electrical apparatus dealer, formerly carrying on business at Central Arcade, Pentrebane St, Caerphilly. Public examination: 10.30 a.m., 14 March, at County Court, Court Hse St, Pontypridd.

Intended Dividends

Manchester. A. F. Guildford, electrical contractor, carrying on business at 52 Mauldeth Rd, West Withington. Last day for receiving proofs for intended dividend: 14 Feb., to trustee: W. H. Meredith, 20 Byrom St, Manchester 3.

Norwich. R. P. Dyke and G. J. Roberts, electrical engineers, carrying on business as Eastern Telectrics at 54 Waterloo Rd. Last day for receiving proofs for intended dividend: 14 Feb., to trustee: C. A. Taylor, Norfolk Hse, Exchange St, Norwich.

Birmingham. A. Fielder, radio and electrical retailer, carrying on business at 314 Shortheath Rd, Erdington, and at 4 Cooksey La. Last day for receiving proofs for intended dividend: 18 Feb., to trustee: W. H. Haigh, Somerset Hse, 37 Temple St, Birmingham 2.

MEETINGS TO NOTE

THURSDAY, 9 FEB.

I.E.E. (Utilisation Section). "Some Notes on the Electrical Requirements of General Cargo Docks," E. R. Radway. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (Cambridge Electronics and Measurement Group). "The Ultrasonic Microscope," C. N. Smyth. Cavendish Laboratory, Cambridge. 8 p.m.

I.E.E. (N. Scotland). "Subscriber Trunk Dialling," D. A. Barron. Electrical Engineering Dept., Queen's College, Dundee. 7 p.m.

I.E.E. (W. Wales). "Discrimination Between h.r.c. Fuses," E. Jacks. Conference Room, S.W.E.B., The Kingsway, Swansea. 6 p.m.

I.E.E. (Southern Graduates and Students). "F.M. Reception," A. C. Davies. C.E.G.B. Generating Station, Poole. 6.30 p.m.

A.S.E.E. (Bradford and District). "Further Developments in Metal Rectifiers," D. Magnall. Midland Hotel, Bradford. 7.30 p.m.

A.S.E.E. (S.W. London). "Progress in Sound Recording," G. M. Nathan. Prince of Wales Hotel, S.W.19. 7.45 p.m.

A.S.E.E. (Oxford and District). "Electric Motor Control Gear," R. F. Mathieson, Reactor School, A.E.R.E., Harwell. 5.45 p.m.

RADAR AND ELECTRONICS ASSOCIATION. "Digital Computors," A. St. Johnston. Royal Society of Arts, John Adam St, W.C.2. 7.30 p.m.

BRITISH ISTITUTION OF RADIO ENGINEERS (Scottish). "Measuring Stability and Spurious Modulation Spectra of High Quality Oscillators," A. L. Whitwell. Institution of Engineers and Shipbuilders, 39 Elmbank Cres, Glasgow. 7 p.m.

FRIDAY, 10 FEB.

I.E.E. (E. Anglian). Annual dinner-dance. Dorothy Restaurant, Cambridge. 7.30 p.m.

I.E.E. (N. Staffs). "Planning and Installation of the Sound Broadcasting Headquarters for the B.B.C.'s Overseas and European Services," F. Axon and O. H. Barron. North Staffs College of Technology, Stoke-on-Trent. 7 p.m.

I.E.E. (N. Scotland). "Subscriber Trunk Dialling," D. A. Barron. Robert Gordon's Technical College, Aberdeen. 7.30 p.m.

I.E.E. (Southern). "Thermo-Nuclear Physics," T. E. Allibone. S.E.B. Showrooms, Newport, I.o.W. 6.30 p.m.

E.P.E.A. (Meter Engineers' Technical Group). "Some Second Thoughts," L. B. S. Golds. Caxton Hall, Westminster, S.W.1. 6.30 p.m.

I.E.E. (N.E. Graduates and Students). "Performance and Design of Artificial Transmission Line with Distributed Parameters," J. P. Patel. Grey Hall, King's College, Newcastle upon Tyne. 6.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Eastern). "Further Training of University Graduates with Particular Reference to Production Engineering," S. H. Potter. Britannia Wks Canteen, Davey Paxman and Co., Colchester. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (S. Western). "Materials Problems in Nuclear Energy," Dr P. Murray. Wheatstone Hall, Brunswick Rd, Gloucester. 7.30 p.m.

MONDAY, 13 FEB.

I.E.E. Discussion: "The Road to Corporate Membership: What is the Responsible Experience Required?" (Joint meeting with the London Graduates and Students.) Savoy Pl, W.C.2. 6 p.m.

I.E.E. (N. Eastern). "The Protection of High-Voltage Insulators from Power Arc Damage," A. E. Guile. Neville Hall, Newcastle upon Tyne. 6.30 p.m.

I.E.E. (N. Western). Discussion: "Laboratory Work for the Institution Examinations." Engineers' Club, Albert Sq, Manchester. 6.15 p.m.

I.E.E. (S. Midlands Supply and Utilisation Group). "The Application of Low-Pressure Resins to Some High-Voltage Switchgear Designs," T. R. Manley, K. Rothwell and W. Gray. College of Advanced Technology, Gosta Green, Birmingham. 6 p.m.

I.E.E. (Scottish Electronics and Measurements Group). "Development of the Formulae of Electromagnetism in the M.K.S. System," P. Vigoureux. Royal College of Science and Technology, Glasgow. 6 p.m.

I.E.E. (Western). "The Surge Flashover Voltages of Air Gaps Associated With Insulators and Bushings," G. W. Bowdler and R. C. Hughes. Electricity Hse, Bristol. 6 p.m.

I.E.S. (Sheffield). Presidential address. Grand Hotel. 6.30 p.m.

A.S.E.E. (Bournemouth and District). Melling Regional Lecture: "Lighting—the Background of Research," S. S. Beggs. Grand Hotel, Firvale Rd. 8 p.m.

A.S.E.E. (Central London). "Operation of Reactors," A. L. Shaw. White Hall Hotel, Bloomsbury Sq, W.C.1. 7.15 p.m.

A.S.E.E. (N.W. London). "Under-floor Heating," R. D. Jackson. Century Hotel, Wembley. 8.15 p.m.

TUESDAY, 14 FEB.

I.E.E. (Education Circle). Discussion: "Technical Teacher Training." Savoy Pl, W.C.2. 6 p.m.

I.E.E. (E. Midlands Electronics and Control Group). "Electronic Telephone Exchanges," J. R. Pollard. College of Further Education, Greenclose La, Loughborough. 6.30 p.m.

I.E.E. (N. Midlands). "The Characteristics and Protection of Semiconductor Rectifiers," D. B. Corbyn and N. L. Potter. Lecture Theatre, Y.E.B. Offices, Ferensway, Hull. 6.30 p.m.

I.E.E. (N. Midlands). Discussion: "The Place of the Technical Institute in the National Certificate Scheme." Branch College of Engineering and Science, Cookridge St, Leeds. 6.30 p.m.

I.E.E. (S. Midlands). Discussion: "Courses at Technician Level on Automatic Control." College of Technology, Gosta Green. 6 p.m.

I.E.E. (N. Western). "Silicon Power Rectifiers," A. J. Blundell, A. E. Garside, R. G. Hibberd and I. Williams. Engineers' Club, Albert Sq, Manchester. 6.15 p.m.

I.E.E. (Southern). Faraday Lecture: "Transistors and All That," L. J. Davies. Guildhall, Portsmouth. 6.30 p.m.

I.E.E. (N. Ireland). "A Survey of Street Lighting and Its Future," W. R. Stevens and H. M. Ferguson. Civil Engineering Dept., David Keir Bldg, Queen's University, Stranmillis Rd, Belfast. 6.30 p.m.

I.E.E. (Scottish Electronics and Measurements Group). "Development of the Formulae of Electromagnetism in the M.K.S. System," P. Vigoureux. Carlton Hotel, Edinburgh. 7 p.m.

Meetings to Note—continued

I.E.E. (Bedfordshire). Discussion: "Machine-Tool Control." Swan Hotel, Bedford. 7 p.m.

N.E. ELECTRICAL CLUB. Ladies' Night. Old Assembly Rooms, Newcastle upon Tyne. 6.30 p.m.

INSTITUTION OF PLANT ENGINEERS (London). A.G.M. and discussion: "Under-floor Heating." Royal Society of Arts, John Adam St, W.C.2. 6.30 p.m.

INSTITUTION OF PLANT ENGINEERS (Manchester). "The Introduction of Planned Maintenance Systems," A. F. Stedman. Engineers' Club, Albert Sq. 7.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Bristol). "The Application of Marine Instruments," E. W. Jordan. University of Bristol, Dept. of Physics, The Royal Fort. 7.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Manchester). "Modern Railway Signalling Methods," C. S. Shute. Nags Head, Jacksons Row. 6.45 p.m.

A.S.E.E. (Aldershot and District). "Electrical Testing Instruments." Queen's Hotel, High St. 8 p.m.

A.S.E.E. (Chester and District). "The Application of Electricity in a Modern Waterworks," D. C. Summerton. Westminster Hotel, City Rd. 7.45 p.m.

A.S.E.E. (E. Kent). "Oil-fired Boilers and Associated Equipment," S. Austin. Clarendon Hotel, Broadstairs. 8 p.m.

A.S.E.E. (Glasgow). "Telephone Equipment." Kenilworth Hotel, Queen St. 8 p.m.

A.S.E.E. (Newcastle upon Tyne and District). "Variable Speed Motors." Roadway Hse, Oxford St. 7.30 p.m.

A.S.E.E. (Portsmouth and District). "Planned Maintenance." Committee Rooms, Ministry of Labour Offices, Lake Rd. 7.30 p.m.

A.S.E.E. (South Wales). "Electrical Safety," S. J. Emerson. Park Hotel, Park Pl, Cardiff. 7.30 p.m.

A.S.E.E. (York). "Electrical Safety in Home and Factory," F. Clark. Royal Station Hotel. 7.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (Electro-acoustics Group). "Some Psycho-acoustic and Engineering Aspects of Hearing Aid Design," J. Jessop. London School of Hygiene and Tropical Medicine, Keppel St, W.C.1. 5.30 p.m.

WEDNESDAY, 15 FEB.

I.E.E. (Supply Section). "A General Theory of Depreciation of Engineering Plant," D. Rudd. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (Rugby). "An Electrostatic Dust Monitor," D. H. Grindell. Rugby College of Engineering Technology. 6.30 p.m.

I.E.E. (Sheffield). "Thermisters: Their Theory, Manufacture and Application," R. W. Scarr and R. A. Setterington. University, Mappin St, Sheffield. 6.30 p.m.

I.E.E. (Bristol Graduates and Students). Discussion: "The Aims and Objects of the Institution." Bristol University. 7 p.m.

I.E.E. (S. Western). "Theory of the Travelling Wave Parametric Amplifier," Professor A. L. Cullen. S.W.E.B., Electric Hall, Torquay. 3 p.m.

I.E.E. (N.W. Graduates and Students). "Colour Television," P. S. Carnt. Engineers' Club, Manchester. 7 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Wolverhampton Graduates). "Spark Erosion and its Applications," B. J. Carver. G.K.N. Research Laboratory, Birmingham New Rd. 7 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (London Graduates). "The Function and Scope of Modern Materials Handling," W. G. Rumble. 10 Chesterfield St, W.1. 7.15 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (S.E. Region). "New Welding Techniques," G. Cubitt-Smith. Hoffmann Social Centre, Chelmsford. 7.30 p.m.

A.S.E.E. (Nottingham). "Recent Developments in Variable Speed A.C. Motors," J. C. H. Bone. Nottingham Mechanics Institution, Trinity Sq. 7.30 p.m.

A.S.E.E. (Wolverhampton and District). "Forensic Science and the Detection of Crime," Detective Chief Inspector Aston. Chamber of Commerce, District Bank Chmbrs, Lichfield St. 7.45 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (S. Western). "High Speed Digital Applications of Transistors," M. L. N. Forrest. Bristol College of Science and Technology. 7 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (Merseyside). "Inertial Navigational Systems," Wing-Cmdr E. W. Anderson. Adelphi Hotel, Liverpool. 7 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Newcastle). "The Education and Training of Instrument Artificers," B. W. Ramsay. Conference Room, Roadway Hse, Oxford St. 7 p.m.

THURSDAY, 16 FEB.

I.E.E. Faraday Lecture: "Transistors and All That," L. J. Davies. Central Hall, S.W.1. 6 p.m.

I.E.E. (Southern). "Silicon Controlled Rectifiers," D. D. Jones. South Dorset Technical College, Weymouth. 6.30 p.m.

I.E.E. (Irish). "Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott. Physical Laboratory, Trinity College, Dublin. 6 p.m.

I.E.E. (N.E. Graduates and Students). "Automatic Position Control of a Machine Tool," N. S. Blyth. Sunderland Technical College. 6.30 p.m.

PLASTICS INSTITUTE. Swinburne Award Address: Prof G. Gee. Royal Institution. 6.30 p.m.

DIESEL ENGINEERS AND USERS' ASSOCIATION. "Diesel Propulsion Machinery for Small Ships," J. B. Griffith. Institute of Marine Engineers, 76 Mark La, London E.C.3. 2.30 p.m.

S. WALES INSTITUTE OF ENGINEERS. "The Single Conductor Multi-channel Signalling and Telemetering System," F. C. Riches. Institute Bldgs, Park Pl, Cardiff. 6 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (E. Midlands). "Instrumentation at the British Sugar Corporation," R. M. J. Withers. University, Leicester. 7.15 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Scotland). A.G.M. and "Some Industrial Applications of Magnetic Power," T. G. Hawker. Institute of Engineers and Shipbuilders, 39 Elmbank Cres, Glasgow C.2. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Southern). "Materials Handling," H. P. Mott. Polygon Hotel, Southampton. 7.15 p.m.

FRIDAY, 17 FEB.

I.E.E. (Electronics and Communications Section). "A Comprehensive Introduction to Plasma Physics," W. B. Thompson. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (E. Midlands). Dinner-dance. Victoria Station Hotel, Nottingham. 7.30 p.m.

I.E.E. (N. Staffs). Annual dinner. Crown Hotel, Stone. 7.30 p.m.

I.E.E. (Cardiff Graduates and Students). "Parametric Amplification," V. David. S. Wales Institute of Engineers, Park Place. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS. "Bio-engineering." H. S. Wolff. Pepys Hse, 14 Rochester Row, S.W.1. 7 p.m.

A.S.E.E. (Stoke and Crewe). "Light as an Aid to Industrial Production," T. Catten. Grand Hotel, Hanley. 7.30 p.m.

MONDAY, 20 FEB.

I.E.E. (Mersey and N. Wales). Third Hunter Memorial Lecture: "The Application of Electronics to the Electricity Supply Industry," J. S. Forrest. (Joint meeting with the N. Western Centre.) Town Hall, Chester. 6.30 p.m.

I.E.E. (N.E. Measurement and Electronics Group). Kelvin Lecture: "Cosmic Radiation," Professor C. F. Powell. Rutherford College of Technology, Northumberland Rd, Newcastle upon Tyne. 6.15 p.m.

I.E.E. (N. Western). Third Hunter Memorial Lecture: "The Application of Electronics to the Electricity Supply Industry," J. S. Forrest. (Joint meeting with the Mersey and North Wales Centre.) Chester Town Hall. 6.30 p.m.

I.E.E. (Sheffield). "Operating Experience at Calder Hall," K. L. Stretch. Angel Hotel, Brigg. 6.30 p.m.

I.E.E. (Western Supply Group). "Short-Circuit Ratings for Mains Cables," G. S. Buckingham; "A Basis for Short-Circuit Ratings for Paper-Insulated Cables up to 11 kV," L. Gosland and R. G. Parr. S. Wales Institute of Engineers, Park Pl, Cardiff. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS (Nuclear Energy Group). Discussion: "The Influence of Availability of Enrichment on Reactor Type and Design." Birdcage Walk, S.W.1. 6 p.m.

BIRMINGHAM ELECTRIC CLUB. "Trends in Distribution Transformer Design and Manufacture," R. Watson. Grand Hotel. 6.15 p.m.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Audel Ltd., Meynell Lodge, Quorn, Leics. Electricians, etc. Nom. cap.: £1,000. Subs.: Mrs A. Warhurst and Wm. H. D. Jenson.

Candell Ltd., 312 Broadmead Rd, Woodford Green. Electrical engineers, etc. Nom. cap.: £10,000. Dirs.: Benjamin G. Heath and Cecil F. Heath.

Carbat Ltd., By-Pass Garage, St. Austell. Manufacturers of and dealers in motor car lamps, electric bulbs, etc. Nom. cap.: £1,000. Dirs.: Wallace C. P. Hughes and Freda M. Hughes.

F. J. Eacott (Electrical Services) Ltd., 27 Woodlands Park Ave, Maidenhead. To take over the business of an electrical engineer carried on as "F. J. Eacott" at Maidenhead, etc. Nom. cap.: £2,000. Dirs.: Francis J. Eacott, Freda I. Eacott and Arthur Duncan.

Eastern Modern Electrics Ltd., 6 Surrey St, W.C.2. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Stanley H. Lucas and Francis A. Dean.

Elac Electronic Components Ltd. Nom. cap.: £10,000. Dirs.: Lionel R. Wragg, 14 Woodland Way, Woodford Green; and Peter W. Pannell.

Electrical Tapes Ltd., Tape Engineering Ltd. and **Paper Tapes Ltd.,** 1 Chignell Pl, W.12. Nom. cap.: £100. Dirs.: not named. Subs.: H. Mason and Mrs D. A. Mason.

Electrocomponents (R-S) Ltd., 73 Basinghall St, E.C.2. Nom. cap.: £10,000. Dirs.: James H. Waring and Paul M. Sebestyen.

W. T. Griffiths (Electrical) Ltd., 12 Millwood Rise, Barry, Glam. Nom. cap.: £1,000. Dirs.: Wm. T. T. Griffiths and Mrs D. Griffiths.

David W. Gunby Ltd. Electricians, electrical, radio and television engineers, etc. Nom. cap.: £4,000. Dirs.: David W. Gunby and Mrs Jean Gunby, 29 Gledhow Park Grove, Leeds 7.

Hampton Electrics Ltd., Bridge Hse, Christchurch, Hants. Television, radio, electrical and electronic engineers, etc. Nom. cap.: £500. Dirs.: Mrs Eileen M. Hampton and Thomas J. Williams.

W. W. Harvey Ltd., 26 Eastwood Rd, Rayleigh. Electrical apparatus, etc. Nom. cap.: £100. Dirs.: Walter W. Harvey and Jeanette P. Wallace.

High Voltage Accessories Ltd., 72 Bridge St, Manchester 2. Electrical engineers and contractors, etc. Nom. cap.: £1,000. Dirs.: Paul Mathews, John R. Ferguson, George G. Heys and Ronald J. Males.

A. E. Hughes and Sons Ltd., 28 Clarence Pl, Newport, Mon. Electricians, electrical contractors and engineers, etc. Nom. cap.: £40,000. Dirs.: Percy S. Hughes and Walter T. Hughes.

Industrial Electrics (Coventry) Ltd., 9 Queen Victoria Rd, Coventry. Electrical maintenance engineers, etc. Nom. cap.: £500. Dir.: Christopher A. Goode.

Jackson and King Ltd., 23 Haslam Ave, Sutton, Surrey. Importers, exporters, manufacturers of and dealers in lighting fittings, etc. Nom. cap.: £100. Dirs.: Herbert F. King and Jack F. Jackson.

K.L. (Birmingham) Ltd., Woodbridge Hse, 1a Woodbridge Rd, Birmingham 13. Motor, electrical and general engineers, etc. Nom. cap.: £100. Dirs. Kurt Landes and Fritzi Landes.

E. Levitt Ltd., 18 Archers Court Rd, Whitfield, nr. Dover. Manufacturers of and dealers in radio, electrical and mechanical apparatus, etc., Nom. cap.: £100. Dirs.: Eric Levitt and Mrs Liese L. C. Levitt.

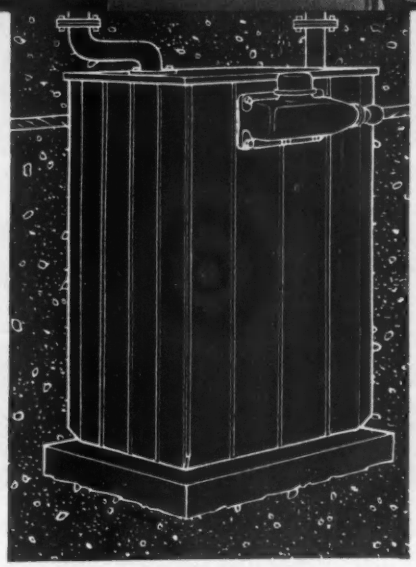
Quality Electrical Developments Ltd. Nom. cap.: £100. Dirs.: Percival H. Main and Mrs A. J. Main, "White Gables," Cherry Tree Rd, Beaconsfield, Bucks.

Thornaby Electrics Ltd., Thornaby Hse, Thornaby Pl, Thornaby-on-Tees, Yorks. To take over business of electrical engineers carried on as "Thornaby Electrics" by Jack Havakin and John Wilson, at Thornaby-on-Tees, Yorks. Nom. cap.: £2,000. Dirs.: Jack Havakin and John Wilson.

Three Shires Electrical Ltd., 93 Three Shires Oak Rd, Bearwood, Smethwick. Dynamo manufacturers and dealers, etc. Nom. cap.: £2,000. Dirs.: Thos. Skidmore and Ronald W. Skidmore.

G. T. Tuffin Ltd., 100 Luton Rd, Harpenden, Herts. Electricians, etc. Nom. cap.: £2,000. Dirs.: Gerald F. Tuffin, Thomas A. Tuffin and Dennis G. Fairhead.

Twin-V Washing Machine (Sales) Co. Ltd., Goldsmith Bldg, Middle Temple, E.C.4. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Shirley Hart and Averill Hart.



Patent Applied For

HACKBRIDGE direct buried type TRANSFORMERS

AN ANSWER TO THE PROBLEM OF INSTALLATION IN CONGESTED AREAS

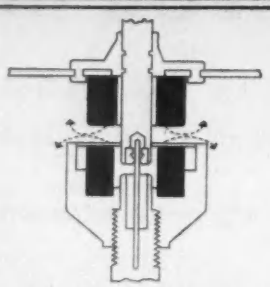
- **Standard naturally cooled oil immersed transformer.**
- **Established reliability.**
- **Minimum space required—only the radiator enclosure is visible above ground.**
- **Low installation cost.**

HACKBRIDGE & HEWITTIC ELECTRIC CO., LIMITED
WALTON-ON-THAMES, SURREY, ENGLAND
Telephone: Walton-on-Thames 28833 (8 lines) *Telegrams & Cables: "Electric, Walton-on-Thames"*

SANGAMO FIRST AGAIN!

NEW MAGNETIC FLOTATION OF DISC ASSEMBLY

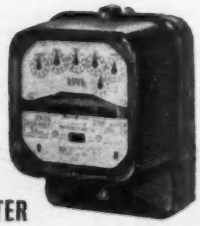
eliminates lower-bearing wear



Two cylindrical Barium-ferrite ceramic magnets, of high coercive force, act with opposing magnetic fields to float the disc completely on a magnetic cushion having a generous clearance of approximately $\frac{1}{16}$" in depth. These magnets, which are surrounded by Mu-temp metal to give full temperature compensation over a range —40°C to +80°C, act as weight neutralizers. Because there is no load or thrust there is virtually no bearing to wear or replace. Accuracy is sustained . . . and maintenance is eliminated.

* New "Floton" bearing gives complete magnetic flotation of disc assembly.
* Even longer life. * No maintenance.
* Unlimited sustained accuracy.

Sangamo are first in production with magnetic flotation of the disc assembly, completely eliminating bearing wear, giving even longer life and sustained accuracy to the world's longest life meter.



sangamo S200.16 SINGLE PHASE WATTHOUR METER

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Telephone: Enfield 3434 (6 lines) & 1242 (6 lines) Telegrams: Sanwest, Enfield

SW 122

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

COUNTY BOROUGH OF DEWSBURY
Street Lighting Department

TENDERS are invited for the supply of:
Class "A" and "B" Concrete Columns.
140 watt and 200 watt Sodium Lanterns.
250 watt and 400 watt M.V. Colour Corrected Lanterns.
Tungsten, Sodium and M.V. Lamps.
Swan-neck Brackets and Spigots.
Control Gear.
Time Switches.

Form of Tender, etc., can be obtained from C. H. MIDSON, M.B.E., Lighting Engineer, 15-19 Victoria Rd, Springfield, Dewsbury, Yorkshire, ONLY ON RECEIPT OF A FOOLSCAP STAMPED ADDRESSED ENVELOPE.

Tenders, enclosed in a PLAIN SEALED ENVELOPE and endorsed "TENDER FOR STREET LIGHTING EQUIPMENT," must be sent to me by Tuesday, 28 Feb., 1961.

A. NORMAN JAMES,
Town Clerk.

Town Hall,
Dewsbury,
Yorkshire.

(T 572)

URBAN DISTRICT COUNCIL OF BRAINTREE AND BOCKING
Installation of electric wiring in The Institute

TENDERS are invited for the above installation at the Institute, Braintree. Only tenders of Contractors listed in the Roll of Approved Electrical Installation Contractors will be considered.

Specification and Schedules can be obtained from the Engineer and Surveyor, Town Hall, Braintree, on payment of a deposit of £2 2s to be refunded on receipt of a bona-fide tender.

Tenders in a plain sealed envelope endorsed "The Institute" must be received by the undersigned not later than noon on Friday, 3 March, 1961.

The estimated value of the work is £1,500/£2,000.

The Council do not bind themselves to accept the lowest or any tender.

W. BALSON,
Clerk of the Council.

(T 524)

APPOINTMENTS VACANT

WEST SUFFOLK COUNTY COUNCIL
COUNTY ARCHITECT'S DEPARTMENT

APPLICATIONS are invited for the post of Electrical Engineer on APT. Grade IV (£1,140/£1,310); commencing salary in accordance with qualifications and experience.

Applicants should hold a university degree or equivalent diploma in electrical engineering or be Associate Members of the Institution of Electrical Engineers, with experience in the design and supervision of electrical lighting and power installations.

Housing accommodation may be made available.

Application forms obtainable from the County Architect, 13 Westgate St, Bury St. Edmunds, to be returned as soon as possible.

(T 463)

CENTRAL ELECTRICITY GENERATING BOARD
East Midlands Division

STATION SHIFT CONTROL ENGINEER
LEICESTER POWER STATION
Vacancy No. 15/61.

APPLICATIONS are invited for the position of Station Shift Control Engineer at Leicester Power Station, Rawdykes Rd, Leicester.

Candidates should be experienced in control room operation. A higher National Certificate would be an advantage.

Salary will be in accordance with Class G, Grade 10 (£890/£1,015 per annum), of the National Joint Board Agreement, plus shift allowance.

Closing date for receipt of applications: 17 Feb., 1961.

GENERAL ASSISTANT ENGINEER
DERBY POWER STATION
Vacancy No. 17/61.

Applications are invited for the position of General Assistant Engineer at Derby Power Station, Full St, Derby.

Candidates should be suitably qualified young men who are interested in power station operation and/or maintenance as a career.

Facilities are available whereby experience can be obtained in all sections of a modern power station, and the prospects of advancement are real to those who are willing to take advantage of the opportunities.

The salary during the initial training period will depend upon qualifications and knowledge, and will be within the range £625/£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications: 17 Feb., 1961.

SHIFT CHARGE ENGINEER
BURTON ON TRENT POWER STATION
Vacancy No. 18/61.

Applications are invited for the position of Shift Charge Engineer at Burton on Trent Power Station, Wetmore Rd, Burton on Trent, Staffs.

Sound technical training and practical experience in the control and operation of steam generating plant and main switchgear are required. Appropriate qualifications an advantage.

Salary will be in accordance with Class E, Grade 7 (£965/£1,090 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 17 Feb., 1961.

FIRST ASSISTANT STATION CHEMIST
LEICESTER POWER STATION
Vacancy No. 19/61.

Applications are invited for the position of First Assistant Station Chemist at Leicester Power Station, Rawdykes Rd, Leicester.

Previous experience in a power station laboratory is essential and candidates should, at least, hold the H.N.C. in Chemistry. Candidates must be familiar with methods of sampling and analysis of coal, oil and water, and with the interpretation and application of analytical results.

Salary will be in accordance with Class G, Grade 9 (£965/£1,090 per annum) of the National Joint Board Agreement.

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PLANNING ENGINEER
WILLINGTON "A" AND "B" POWER STATIONS
Vacancy No. 20/61.

Applications are invited for the position of Planning Engineer at Willington "A" and "B" Power Stations, P.O. Box 27, Derby.

Applicants should have held a position of responsibility in a modern power station and should have received a thorough practical and theoretical training.

Preference will be given to candidates who are Corporate Members of a recognised professional institute or who hold qualifications leading to such membership, and candidates should have a clear and objective approach to power station planning problems.

Salary will be in accordance with Class M, Grade 6 (£1,650/£1,830 per annum) of the National Joint Board Agreement.

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EFFICIENCY ENGINEER
WILLINGTON "A" AND "B" POWER STATIONS
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Applications are invited for the position of Efficiency Engineer at Willington "A" and "B" Power Stations, P.O. Box 27, Derby.

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SECOND ASSISTANT STATION CHEMIST
LEICESTER POWER STATION
Vacancy No. 22/61.

Applications are invited for the position of Second Assistant Station Chemist at Leicester Power Station, Rawdykes Rd, Leicester.

Experience of analyses of fuel, water and oils is desirable and educational standard up to Higher National Certificate would be an advantage.

Salary will be in accordance with Class G, Grade 11 (£825/£940 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 17 Feb., 1961.

GENERAL ASSISTANT ENGINEER (CHEMIST)
CASTLE DONINGTON POWER STATION
Vacancy No. 23/61.

Applications are invited for the position of General Assistant Engineer (Chemist) at Castle Donington Power Station, nr. Derby.

Candidates should possess the Ordinary National Certificate in Chemistry as a minimum qualification, and should have previous experience in the analysis and testing of coal, water and oil, preferably in a power station laboratory.

The salary will be within the range £625/£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications: 24 Feb., 1961.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT, which may be obtained from the Station Superintendent concerned, and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.

(T 562)

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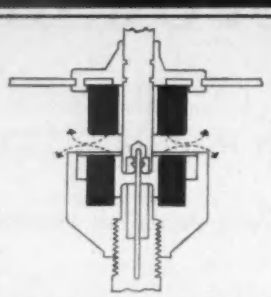

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MINISTRY OF AVIATION

require

ENGINEER II

IN National Gas Turbine Establishment, Pyestock, Farnborough, Hants, to be responsible for maintenance and control of electrical equipment comprising large electrical motors, high and low voltage switchgear and general high and low voltage distribution systems. Quals.: Recognised engineering apprenticeship and corporate membership of Institution of Electrical Engineers or equiv. Knowledge of design of electrical circuitry advantageous. Salary: £1,245/£1,680 p.a. (Provincial: improved scales shortly available.) Not established, but opportunities to compete for establishment may arise. Forms from Ministry of Labour, Technical and Scientific Register (K), 26 King St, London S.W.1, quoting D.35/1A. (T 546)

THE SOUTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable positions:

THIRD ASSISTANT ENGINEER (SUBSTATIONS)

on the staff of the Area Engineer, Monmouthshire and Mid-Wales area, at Cwmbran.

Preference will be given to engineers possessing the Higher National Certificate in Electrical Engineering.

Salary: N.J.B., Scale 9, Class K, Grade 10 (£1,115/£1,245 per annum).

Applications stating age, present position, present salary, qualifications and experience should be addressed to D. G. Gwyn, B.SC., A.M.I.E.E., Manager, Monmouthshire and Mid-Wales Area, Llywelyn Rd, Cwmbran, Mon, to arrive not later than 25 Feb., 1961.

Please quote reference 11/61/ET, endorsing envelope "Third Assistant Engineer."

ASSISTANT ENGINEER

in the South Cardiganshire District (Cardigan) in the West Wales Area of the Board.

Preference will be given to engineers possessing the Higher National Certificate in Electrical Engineering.

Salary: N.J.B., Scale 3, Class D, Grade 10 (£715/£805 per annum).

Applications stating age, present position, present salary, qualifications and experience should be addressed to W. E. Richardson, M.I.E.E., Manager, West Wales Area, South Beach Pavilion, Tenby, Pembs, to arrive not later than 25 Feb., 1961.

Please quote reference 13/61/E, endorsing envelope "Assistant Engineer."

R. G. WILLIAMS,
Secretary.
(T 547)

CIVIL SERVICE COMMISSION

MECHANICAL AND ELECTRICAL ENGINEERS

PENSIONABLE posts for men and women normally under 35 on 1 March, 1961. Applicants must normally have degree or Dip. Tech. in engineering or physics or have passed examinations necessary for A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.F.R.Ae.Soc., etc. Exceptionally, evidence of high professional attainment acceptable in lieu. Practical training and experience required but untrained graduates acceptable for some posts. Starting salary (London) from £961 (lower if under 25) to £1,298. Maximum £1,470. Promotion prospects. Write Civil Service Commission, 17 North Audley St, London W.1, for application form, quoting S/85/61. Closing date: 29 March, 1961. Earlier applicants may be interviewed before that date. (T 545)

CITY OF SALISBURY — ELECTRICITY DEPARTMENT

VACANCY FOR ELECTRICAL ENGINEER (PROTECTION)

SALARY Scale: £1,025 x £102 10s—£1,332 10s x £76 17s 6d—£1,563 2s 6d x £51 5s—£1,768 2s 6d per annum.

Applications are invited for the fixed establishment post of Electrical Engineer (Protection) in the Salisbury Municipal Electricity Department on the scale: £1,025 x £102 10s—£1,332 10s x £76 17s 6d—£1,563 2s 6d x £51 5s—£1,768 2s 6d per annum. No allowances are payable.

Commencing salary is based on qualifications and experience. There is a barrier at £1,563 2s 6d per annum, above which no engineer can rise without being a corporate member of the British Institution of Electrical Engineers, and the maximum entry point into the grade is £1,614 7s 6d per annum.

Candidates must be graduates of the British Institution of Electrical Engineers and/or hold an equivalent electrical engineering degree, and have had not less than five years' experience in general protection work.

Consideration, however, will be given to applicants who have not the above qualifications but who have had extensive practical experience. The salary scale applicable in such instance will be £1,568 5s x £51 5s—£1,722 per annum, commencing salary being at the minimum of the grade.

The successful applicant will work under the direction of the Test Engineer in the Consumers' Engineer's Section and his duties will comprise mainly:

1. Design and commissioning of all types of protection schemes on generators, feeders, motors, transformers and other types of electrical equipment.

2. Determination of relay settings and the calculation of fault currents over the system. Supervision of staff engaged in the maintenance and repair of all relays and instruments associated with protection schemes.

The Department has an extensive supervisory indication, control and telemetering scheme and experience with similar equipment is desirable. Experience with electronic equipment would be considered an advantage.

The appointment will be subject to the City Council's Service and Leave Regulations. The successful candidate will be required to furnish to the Council a satisfactory medical certificate of fitness and to serve a probationary period of not less than six months and, if thereafter confirmed in his appointment, to join the Southern Rhodesia Local Authorities Joint Pension and Widows' and Orphans' Fund. He must also be able to comply with the requirements of the Federal Immigration Authorities.

Candidates must submit full particulars of their qualifications, training and experience, giving details of positions held and salaries received. Age, place of birth, nationality and marital state should be stated and copies of not more than three recent testimonials may be forwarded.

Particulars of the undertaking and a summary of conditions of service, pension and leave entitlements, etc., may be obtained from Messrs Merz and McLellan, Carliol Hse, Newcastle upon Tyne 1, quoting reference PN, to whom applications must be submitted on or before 17 Feb., 1961. (T 461)

CENTRAL ELECTRICITY GENERATING BOARD

South Eastern Division

LITTLEBROOK POWER STATION

Vacancy No. 48/61

SHIFT CHARGE ENGINEER

THE successful applicant would be expected to take charge of 480 MW of plant and should have had experience in a modern power station. Possession of H.N.C. together with operational experience of P.F. and Oil Firing would be an advantage.

Salary: N.J.B. Class L, Grade 6, £1,748 10s/£1,952 including London and Shift Allowances.

Applications, giving age and details of experience, qualifications, etc., should be sent to the Station Superintendent, Littlebrook Power Station, near Dartford, Kent, to arrive by 21 Feb. (T 555)

L.C.C. SOUTH EAST LONDON TECHNICAL COLLEGE
LEWISHAM WAY, S.E.4.

Department of Electrical Engineering

APPLICATIONS are invited for

LECTURERS AND ASSISTANT LECTURERS (GRADE B)

in Telecommunications and/or Light Current Electrical Engineering.

Candidates should be well qualified, have industrial experience and preferably some teaching experience.

The Department offers Full-time, Sandwich, Part-time Day and Evening Courses. The successful candidate should be able to teach up to Part III I.E.E. and/or C. and G. Telecommunications supplementary studies standard respectively.

Salary scales:

(i) Lecturers £1,408/£1,601 with possible entry above the minimum.

(ii) Assistant Lecturers (Grade B) appointment within scale £738/£1,201 with additions as approved to a possible maxmium of £1,486 for degree, good honours and suitable full-time study on research.

Point of entry and maximum dependent on relevant industrial or teaching experience and qualifications.

Application forms from the Secretary, returnable within two weeks. Please quote (FE.3a/T/224/2). (T 525)

GOVERNMENT OF WESTERN NIGERIA

Vacancy for

SENIOR ELECTRICAL ENGINEER

APPLICATIONS are invited for the post of Senior Electrical Engineer.

QUALIFICATIONS. Chartered membership of the Institution of Electrical Engineers, plus a minimum of five years' responsible experience.

DUTIES. Responsibility for the design of all electrical installations in public buildings or Regional Government Property in Western Nigeria; for the specifying of plant and materials, their procurement, the organisation of labour and technical personnels, the preparation of and adjudication of tenders, the supervision of works and the accounting for expenditure in connection with these works.

CONDITIONS OF APPOINTMENT. On contract for two tours of 12-18 months each in the first instance on a Salary of £2,748 per annum. In addition, gratuity is paid at the rate of £37 10s for each completed three months' service. Free first-class passages for officer and his family on first appointment and when proceeding on leave; free medical treatment for officer and his family. Accommodation is provided at low rentals.

METHOD OF APPLICATION. Applications should be completed in triplicate on the prescribed form obtainable from the Official Secretary (Recruitment Branch), Office of the Agent-General for Western Nigeria, 178/202 Great Portland St, London W.1, from whom further particulars may also be obtained. Closing date: 2 March, 1961. (T 527)

THE NORTH WESTERN ELECTRICITY BOARD

FOREMAN (OVERHEAD LINES)

STALYBRIDGE DISTRICT

DUTIES will include the supervision of construction and maintenance of overhead lines, including the maintenance of steel tower 33 kV lines.

Salary: £795 p.a. Grade 2. Schedule E. N.J.I.C. Conditions.

Applications to Manager, No. 3 Sub-Area, The North Western Electricity Board, Union St, Oldham, by 18 Feb., 1961. (T 522)

RHODESIA AND NYASALAND

THE Federal Ministry of Education invites applications from men under 50 for the post of

LECTURER OR ASSISTANT LECTURER IN ELECTRICAL ENGINEERING
THE POLYTECHNIC, SALISBURY

Previous teaching experience is not essential, but an enthusiasm for experimental investigation in the light current field is necessary.

Salary Scales:

Assistant Lecturer: £997 10s x £52 10s—£1,050 x £105—£1,260 x £52 10s—£1,785.

Lecturer: £1,522 10s x £52 10s—£1,890.

A Lecturer must hold a University degree or equivalent and have had at least two years' relevant post-qualification experience in industry or teaching. On the Assistant Lecturer scale up to six increments are allowed for experience; on the Lecturer scale up to four increments are allowed for industrial and/or teaching experience over and above that required as a qualification for entry.

Service is permanent and pensionable; pensions are generous and there is a widows' and children's pension scheme. The passages of the Lecturer or Assistant Lecturer appointed, his wife and dependent children under 18, are paid to the Federation.

Accommodation is not provided, but there is no difficulty in obtaining it privately in Salisbury. Facilities for the education of children are exceptionally good and the climate is very agreeable.

Full information on the scope of the work, entry points into the salary scale, terms of service, conditions of life, etc., may be obtained together with application forms, from the Education Liaison Officer, Rhodesia Hse, 429 Strand, London W.C.2.

Applications should be submitted not later than 6 March and the date of appointment will be settled by mutual agreement. (T 542)

THE NORTH WESTERN ELECTRICITY BOARD

SENIOR DEMONSTRATOR

THE North Western Electricity Board require a Senior Demonstrator for their Wigan District covering an area of 74 square miles with four Service Centres.

Candidates should have a good knowledge of electrical appliances and be competent to give demonstrations and lectures in public halls, Service Centres and on consumers' premises on cooking, laundering and housecraft subjects. The successful person will be required to assist in general Service Centre duties, as required, during normal hours of business.

The possession of a recognised diploma in domestic science or the E.A.W. Certificate in Electrical Housecraft would be an advantage.

Salary: £700/£775 p.a. Superannuation scheme; annual holidays up to a maximum of three weeks three days.

Applications on forms to be obtained from the Manager, No. 2 Sub-Area, The North Western Electricity Board, 2 St. George's Rd, Bolton, and returned to him by 20 Feb., 1961. (T 523)

SOUTH WESTERN ELECTRICITY BOARD

IBM MACHINE ROOM SUPERVISOR

APPLICATIONS are invited from persons aged 25/40 for the appointment of Machine Room Supervisor for a large IBM installation in Plymouth.

Salary within Grade 6, £1,150/£1,240 per annum, of the N.J.C. Agreement.

The person appointed will be responsible to the Principal Assistant (Machine Planning and Operation) for the day-to-day running of the machine installation, which includes three 604 Calculators and ten 421/441 Accounting Machines.

Applicants should have a sound theoretical and practical knowledge of punched card methods as applied to billing, payrolls, stores, costing and expenditure analysis and must be capable of supervising a large staff.

Applications to be made on Standard Form AE6/ACT obtainable from the Accountant in Charge, Central Accounting Office, South Western Electricity Board, Beaumont Rd, Plymouth. Closing date for completed applications is 25 Feb., 1961. (T 528)

PORT OF BRISTOL AUTHORITY

AN ASSISTANT ENGINEER (ELECTRICAL)

APPLICATIONS are invited for the above post, to be graded APT. IV, £1,140/£1,310. The appointed candidate will work under the direction of the Chief Assistant Engineer (Electrical), whose duties include the installation, operation and maintenance of electrical equipment and the specification and control of new works. Electricity consumption approximately 17,000 kW and 75 million units per annum.

2. Candidates should have served an approved apprenticeship and be Graduate or Associate Members of the Institution of Electrical Engineers.

3. The successful candidate will have to pass a medical examination before appointment. The position is pensionable under the provisions of the Local Government Superannuation Acts.

4. Applicants must disclose whether they are related to a member or senior officer of the Bristol Corporation. Canvassing disqualifies.

5. Applications, stating age, qualifications, experience, etc., and enclosing copies of any supporting documents, must reach me by 10 a.m. on 2 March, 1961.

T. L. MARTIN,
Engineer-in-Chief.

Port of Bristol Authority,
Avonmouth Docks,
Bristol. (T 529)

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for the undernoted superannuable appointments at Hunterston Nuclear Generating Station:

(a) STATION CHEMIST
(Ref. G4/61)

The successful applicant will supervise the conventional and radiochemical station laboratories and be responsible for the testing and treatment of waters, gases and oils, radioassay of effluents and plant arisings and measurement of activity levels in district survey samples. Candidates should have had experience in a modern generating station and possess a University Degree or equivalent qualification. The successful applicant will be expected to undergo special training with the U.K.A.E.A.

Salary: N.J.B. Class M, Grade 6, £1,650/£1,830 per annum.

(b) ASSISTANT STATION CHEMIST
(Ref. G5/61)

The successful applicant will be responsible to the Station Chemist for the work of the district survey laboratory, measuring the levels of total activity and of specific isotopes in district survey samples. He may also be expected to participate in routine station chemical analyses. Candidates should preferably have had some experience of low level activity measurements and background counting techniques and possess a Higher National Certificate, or equivalent qualification.

Salary: N.J.B. Class M, Grade 9, £1,350/£1,500 per annum.

Forms of application may be obtained from the Secretary, South of Scotland Electricity Board, Inverlair Ave, Glasgow S.4, and returned quoting appropriate reference, not later than 24 Feb., 1961. (T 553)

SOUTH OF SCOTLAND ELECTRICITY BOARD

APPLICATIONS are invited for a superannuable position as a

PLANT SHIFT CONTROL ENGINEER
AT KINCARDINE GENERATING STATION

Applicants should have experience of Station Control Room duties in a modern generating station and possess qualifications of Higher National Certificate standard or equivalent. The duties will include operation and supervision of all control equipment associated with main plant.

Salary: N.J.B., Class K, Grade 10, £1,115/£1,245 rising ultimately to Class M, Grade 10, £1,275/£1,410 (plus shift allowance of 10% per annum).

Housing accommodation may be made available if required.

Applications, on the standard form and quoting reference number G2/61, should be submitted to the Secretary, South of Scotland Electricity Board, Inverlair Ave, Glasgow S.4, not later than 17 Feb., 1961. (T 479)

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

APPLICATIONS are invited for appointment as

LECTURER IN ELECTRIC TRACTION

in the Department of Electrical Engineering, to work with a Reader to establish new section for post-graduate teaching and research in this subject. Salary in range £1,050 x £50—£1,400 x £75—£1,850 plus £60 London Allowance, Family Allowances and F.S.S.U. membership. Appointment will be in upper range for candidate with appropriate qualifications. Thorough knowledge of machines and rectifiers is of more importance than extensive experience in traction. Applications to Head of Electrical Engineering, Department, Imperial College of Science and Technology, Prince Consort Rd, London S.W.7, by 20 Feb., 1961. (T 526)

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION

APPLICATIONS are invited from qualified men within the age bracket 30/35 for the post of

TECHNICAL ASSISTANT

in the Switchgear Department at Ascot.

Applicants should have:

(a) a good educational background;
(b) experience with switchgear and ancillary equipment;
(c) administrative ability, personality and tact.

Some familiarity with the work of technical committees and the production of specifications would be an advantage.

A salary will be paid commensurate with qualifications and experience. There is a contributory staff superannuation scheme.

Applications should be addressed to the Secretary of the Association, 36 Kingsway, London W.C.2. (T 533)

EAST ANGLIAN REGIONAL HOSPITAL BOARD

Regional Engineer's Department

(1) ENGINEERING MAIN GRADE
(MECHANICAL)

(a) Corporate members, Inst.Mech.E. Salary: £1,160/£1,600.

(b) Corporate members, Inst.H. and V.E. Salary: £910/£1,400.

(c) Graduate members, Inst.Mech.E. Salary: £910/£1,205.

(2) ENGINEERING MAIN GRADE
(ELECTRICAL)

Graduate members, Inst.E.E. Salary: £910/£1,205.

Candidates appointed will be engaged on design of central heating and hot water systems, air conditioning equipment, etc., including design of steam boiler plant, laundry installations, etc.; or electric lighting and power installations, radio and telephone installations and electronics in relation to hospital engineering projects. Experience in estimating and in preparation of specifications desirable.

Candidates appointed under 1(a) or 1(b) will be responsible for small design team for all aspects of mechanical engineering services in large hospital building projects.

Graduate members of the Institutions of Mechanical and Electrical Engineers automatically proceed by increments to maximum of Grade (£1,600) upon being admitted to corporate membership.

(3) ENGINEERING DRAUGHTSMEN
(MECHANICAL AND ELECTRICAL)

Grade I, salary: £1,030/£1,250.
Grade II, salary: £870/£1,010.
Grade III, salary: £550/£850.

Candidates for I and II should preferably have H.N.C. or O.N.C. and be experienced in the design of engineering works and the preparation of tender drawings and specifications under supervision.

Candidates for III should have had minimum of three years' practical training including site or workshop experience. Knowledge of engineering drawing and estimating an advantage.

Applications stating age, qualifications, experience and details of present position with names of three referees to Secretary of Board, 117 Chesterton Rd, Cambridge, by 3 March, 1961. (T 496)

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division

Vacancy No. 28/ET/61.

APPLICATIONS invited for the superannuable N.J.B. appointment of

ASSISTANT SHIFT CHARGE ENGINEER

at Llynfi Power Station, nr. Bridgend, Glam. Salary Schedule A, Class G, Grade 9, Scale 7 (£965/£1,090 per annum, plus 10% shift enhancement).

Applicants should possess Higher National Certificate or equivalent qualifications and have had operating experience in a modern power station.

Special application forms obtainable from Divisional Secretary, South Wales Division, Central Electricity Generating Board, Twyny-fedwen Rd, Gabalfa, Cardiff, to be returned by 25 Feb., 1961. (T 557)

SOUTHERN ELECTRICITY BOARD

FIELD ENGINEER (CONSTRUCTION)

SUB-AREA Engineering Department of No. 3 (Portsmouth) Sub-Area. Salary: N.J.B. Class L, Grade 13 (£965/£1,090 per annum). N.J.B. Conditions of Service.

The duties of the post will be to carry out site supervision, installation and erection of plant, equipment and overhead lines, the laying of cables and other constructional work on all distribution systems up to and including 33 kV.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton La, Cosham, Portsmouth, and returned to him, quoting Z.1312, not later than 20 Feb., 1961.

ASSISTANT ENGINEER (LOCAL)

Yeovil District of No. 4 (Bournemouth) Sub-Area, located at Shaftesbury. Salary: N.J.B. Class F, Grade 10 (£825/£940 per annum). N.J.B. Conditions of Service.

Applicants should have had experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems. The possession of suitable technical qualifications would be an advantage. The successful candidate will be required to carry out standby duties if and when called upon to do so.

Applications on forms obtainable from the Suub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1313, not later than 20 Feb., 1961.

GENERAL ASSISTANT ENGINEER

Weymouth District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B. Class F, Grade 11 (765/£870 per annum). N.J.B. Conditions of Service.

Applicants should have had sound experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution mains and substations. The possession of suitable technical qualifications would be an advantage. The successful candidate will be required to carry out standby duties if and when called upon to do so.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1311, not later than 20 Feb., 1961.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (T 559)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

SECOND ASSISTANT ENGINEER (PROTECTION)

REQUIRED at No. 1 Sub-Area Headquarters. Salary within range £1,535/£1,720 per annum (N.J.B. M/7).

Duties will include power system protection and the testing and commissioning of h.v. cables, switchgear, transformers, and associated equipment up to 33 kV.

Applicants should have had a general experience in the Electricity Supply Industry, and be technically qualified.

Appointment subject to medical examination. Pension Scheme.

Application forms, obtainable from the Manager, No. 1 Sub-Area, 24 Hatton Garden, Liverpool 3, should be returned not later than 27 Feb., 1961. (T 569)

CROWN AGENTS FOR OVERSEA GOVERNMENTS AND ADMINISTRATIONS

ASSISTANT ENGINEER (ELECTRICAL)

REQUIRED for the London Office for appointment normally to pensionable establishment on probation for two years. Commencing salary between £991 at age 25 and £1,318 at age 34 or over in scale rising to £1,490. Fully qualified officer at least 27 years of age may be eligible for special increase of £75 within maximum of scale after two years' service. Liberal leave. Five-day week.

Candidates, preferably between 25 and 35 years of age, should have degree in Electrical Engineering or be Corporate or Graduate Members of the Institution of Electrical Engineers. They should have received their training with established electrical manufacturer, contractor or undertaking and have had subsequent operating or design experience in either medium sized thermal power stations, transmission and distribution systems, or consumers' installations. Previous contract experience an advantage.

Duties include purchase of electrical plant and equipment, preparation of specifications for tenders, adjudication of tenders and technical correspondence with administrations.

Apply to Crown Agents, 4 Millbank, London S.W.1, for further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2A/51092/EE.

(T 564)

CITY OF SALISBURY-ELECTRICITY DEPARTMENT

VACANCY FOR

SENIOR ELECTRICAL ENGINEER (INSTALLATION)

SALARY Scale: £1,768 2s 6d x £51 5s 0d—£1,921 17s 6d. p.a.

Applications are invited for the fixed establishment post of Senior Electrical Engineer (Installation) in the Salisbury Municipal Electricity Department, on the above scale, commencing salary at the minimum of the grade. No cost of living or other allowances are payable.

Candidates must be corporate members of the British Institution of Electrical Engineers and/or hold an equivalent electrical engineering degree.

The post requires experience in the general application of electricity to industrial, commercial and domestic premises, the preparation of estimates for and planning of such installations, general knowledge of Electricity Regulations, and the commissioning and maintenance of electrical plant and installations. The successful candidate will serve in the Consumers' Engineer's Section as assistant to the Installation Engineer.

The appointment will be subject to the City Council's Service and Leave Regulations. The successful candidate will be required to furnish to the Council a satisfactory medical certificate of fitness and to serve a probationary period of not less than six months, and if thereafter confirmed in his appointment, to join the Southern Rhodesia Local Authorities' Joint Pension and Widow's and Orphans' Fund. He must also be able to comply with the requirements of the Federal Immigration Authorities.

Candidates must submit full particulars of their qualifications, training and experience, giving details of positions held and salaries received. Age, place of birth, nationality and marital status should be stated and copies of not more than three recent testimonials may be forwarded.

Particulars of the undertaking, and a summary of conditions of service, pension and leave entitlements, etc., may be obtained from Messrs Merz and McLellan, Carliol Hse, Newcastle upon Tyne 1, to whom applications must be submitted on or before 3 March, 1961. (T 550)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

Board Headquarters

COMMERCIAL ASSISTANT

(SALES, PUBLICITY AND SERVICE SECTION CHIEF COMMERCIAL OFFICER'S DEPARTMENT)

Applicants should have a wide knowledge of modern sales techniques and the ability to give instruction in such techniques on courses dealing with the selling of all types of electrical apparatus and involving the basic sales training of new entrants and the specialised training of existing staffs. The successful applicants will also be required to assist as directed with general duties associated with sales promotion and development, and the possession of suitable qualifications will be an advantage. The appointment will be made within the scales of the appropriate negotiating machinery at a salary within the range £1,105/£1,500 per annum according to qualifications and experience. Apply, by letter, within 14 days, stating age, experience, qualifications, present salary and position, to The Secretary, Midlands Electricity Board, Mucklow Hill, Halesowen.

Wolverhampton & District Sub-Area

FOURTH ASSISTANT ENGINEER (HEADQUARTERS)

Duties will be of a general nature within the Technical and Planning Section. Salary according to experience and qualifications, £965/£1,090 per annum (N.J.B. Grade L.13) or £1,040/£1,165 per annum (N.J.B. Grade L.12).

THIRD ASSISTANT DISTRICT ENGINEER (LICHFIELD)

Applicants should have had experience in the construction and maintenance of high and medium voltage distribution system. Technical qualifications desirable. Salary: £825/£940 per annum (N.J.B. Grade E.9).

Apply, by letter, within 14 days, stating age, experience, present position and salary, to Mr D. Holt, Sub-Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

F. W. CATER,
Secretary.
(T 544)

THE NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments which are subject to the conditions of the National Joint Board.

Wear Sub-Area

DISTRICT ENGINEER HESLEDON

Applicants should be suitably qualified engineers and must have had a sound practical training and considerable experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution networks, substation plant and auxiliary equipment.

Salary Schedule A, Class G, Grade 2, £1,535/£1,720 p.a.

York Sub-Area

THIRD ASSISTANT ENGINEER (OPERATION AND MAINTENANCE SECTION) SUB-AREA HEADQUARTERS, YORK

Applicants should preferably have had experience of operation and maintenance duties in E.H.V., H.V. and L.V. networks supplying urban and rural areas.

Salary Schedule A, Class H, Grade 10, £965/£1,090 p.a.

Applications stating age, qualifications and experience to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle upon Tyne, within ten days of the appearance of this advertisement. (T 566)

THE NORTH WESTERN ELECTRICITY BOARD
ASSISTANT SECRETARY (EDUCATION)

APPLICATIONS are invited for the post of Assistant Secretary (Education).

The duties of the successful applicant will include the administration of a comprehensive training policy for all types of employees, and the organisation of internal training courses.

Applicants should be graduates of a British University and should have had appropriate experience in industry.

The salary will be in accordance with Class D, Grade 4, of the N.J.M. and H.E.G. Committee Agreement, i.e., £2,170 x £75—£2,320 x £60—£2,380, and the successful candidate will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme if eligible.

Applications, on forms to be obtained from me at the North Western Electricity Board, Cheetwood, Rd, Manchester 8, should be received by the Board not later than 27 Feb., 1961.

J. W. K. EVANS,
Secretary.
(T 549)

CENTRAL ELECTRICITY GENERATING BOARD
SENIOR ASSISTANT ENGINEER

REQUIRED in the Commercial Department at Headquarters, London S.E.1.

The duties will include assisting in the preparation of estimates of the cost of supply of electricity, of revenue and capital budgets and of long and short term trading forecasts; analyses of the costs of supply and detailed work in connection with Bulk Supply Tariffs.

Candidates should have a good technical education and experience in the commercial or economic aspects of electricity supply. Preference will be given to those who possess an engineering degree or are members of a senior engineering institution.

Salary within the range £1,805/£2,295 p.a.

Applications stating age, qualifications, experience, present position and salary, to the Appointments Officer, 24-30 Holborn, London E.C.1, by 1 March. Envelopes should be marked "Confidential, Ref. ET/57." (T 560)

MINISTRY OF TRANSPORT, NORTHERN RHODESIA
ELECTRICAL ENGINEER

QUALIFICATIONS: University Degree in Electrical Engineering or A.M.I.E.E. essential, together with at least two years' post qualification experience in a responsible engineering appointment covering the duties below.

Duties: To prepare designs, drawings and specifications and to tender documents for a wide range of electrical installations, including diesel generating sets, in Government buildings and public institutions.

Age: Preferably between 28 and 35.

Terms: Three-year contract. Starting salary at appropriate point in scale £1,315/£1,995 per annum (at present under review). Additional 5% allowance and gratuity. Free passages. Rented quarters. Generous leave.

Apply Director of Recruitment, Colonial Office, London S.W.1, giving full names, age and details of qualifications and experience, quoting BCD 119/3/03/D10. (T 578)

SENIOR CONTRACTING ENGINEERS

required by National Contractors. Wide experience of all types of Electrical Installations essential. Bonus Scheme. Contributory Pension Scheme with Life Assurance. Write under private cover stating age, experience and salary required to Duncan Watson (Electrical Engineers) Ltd., Andrew Hse, 60 Worship St, London E.C.2.

(T 576)

CENTRAL ELECTRICITY GENERATING BOARD
South Western Division
Vacancy No. ET/AV/20/61.
GENERAL ASSISTANT ENGINEER
(DRAWING OFFICE)

REQUIRED in the Electrical Department.

Superannuation Scheme. Salary: N.J.B. Class AX, Grade 14, Scale 4, £685/£870 per annum.

Applications are invited for a General Assistant Engineer (Drawing Office) in the Electrical Department of the South Western Division for work associated with high voltage transforming and switching stations. Applicants should be competent draughtsmen, should have a good general and technical education and preferably have obtained, or be studying for, the Ordinary National Certificate in Electrical, Mechanical or Civil Engineering, or an equivalent qualification.

Vacancy No. ET/AV/21/61.
ASSISTANT ENGINEER
(DRAWING OFFICE)

Required at Hinkley Point Power Station.

Superannuation Scheme. Salary: N.J.B. Class O, Grade 16, Scale 7, £965/£1,090 per annum.

Applicants should be able to lay out schematic diagrams and general arrangements on electrical and mechanical plant and be able to do detail drawings from sketches. The duties will also include some of a general nature which will offer scope for the widening of experience and future promotion. Applicants should preferably possess or be studying for a Higher National Certificate or equivalent qualifications.

Applications on Form AE6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by Monday, 20 Feb., 1961.

Please quote appropriate Vacancy No. (T 565)

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

APPLICATIONS are invited for a post of
SENIOR LECTURER IN ELECTRICAL ENGINEERING
commencing 1 May, 1961, or by arrangement.

Candidates should preferably be honours graduates with industrial and/or teaching experience and possess corporate membership of the Institution of Electrical Engineers.

Salary in accordance with the Burnham Technical Scale for Senior Lecturers, viz.: £1,550 x £50—£1,750 per annum. Full allowance up to the maximum of the scale is given for appropriate experience.

Further particulars and application form will be sent by the undersigned. Last date for the receipt of applications: Friday, 3 March, 1961.

E. C. SMITH,
Principal.
(T 567)

EASTERN ELECTRICITY BOARD
Northmet Sub-Area
FOURTH ASSISTANT ENGINEER
(OPERATION AND MAINTENANCE)
SUB-AREA ENGINEER'S DEPARTMENT
(Ref. 1013)
18/61.R.

APPLICANTS should be qualified and experienced in the maintenance of distribution plant on systems of 33 kV and below and be capable of co-ordinating maintenance programmes, advising on methods and investigating faults.

The successful candidate will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Salary: N.J.B. Class N, Grade 12 (£1,240/£1,375), inclusive of London Allowance.

Apply by letter to the Manager, Eastern Electricity Board, Northmet Sub-Area, Northmet Hse, Southgate, London N.14, by 20 Feb., 1961. (T 556)

APC

Vacancies exist for enthusiastic engineers and physicists in the Construction and Commissioning Department of the Company.

ENGINEERS and PHYSICISTS are required as members of the Commissioning Team for the Nuclear Power Station at Trawsfynydd, North Wales, and for future projects. The work will initially be in London, but successful applicants will be transferred to North Wales at the time of the commissioning of the power station. Applicants should be technically qualified, and have some experience of either nuclear physics or the operation and commissioning of power station plant, but further training will be given as appropriate. A number of appointments are to be made at both Senior and Junior levels.

Vacancies also exist for Junior Engineers in the Department at Head Office, where the work is generally that of programming, progressing and liaising with site during the construction of major undertakings.

Applications giving full details of qualifications and experience should be sent to:

The Personnel Manager (Ref. ET/166),
Atomic Power Constructions Limited,
28 Theobalds Rd,
London W.C.1 (T 538)

THE NORTH WESTERN ELECTRICITY BOARD
DISTRICT COMMERCIAL ENGINEER
SOUTH WEST DISTRICT
ALTRINCHAM

DUTIES will include the organisation and control of all commercial staff and functions of the District; supply of information, and advice to all classes of consumers on electricity utilisation, tariffs, and all matters concerning electricity services, organisation and supervision of contract wiring work and maintenance services on consumers' premises; control of service centres, demonstrations, exhibitions, etc; organisation and supervision of consumer records.

Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £1,795/£1,950 p.a., Grade J.2. N.J.B. Conditions.

Applications on forms to be obtained from the Manager, (Staff Vacancy), No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493, and returned to him by 22 Feb., 1961. (T 548)

BOWATER PACKAGING LIMITED

Plant Engineer of new modern factory at Gillingham, Kent, requires a qualified ELECTRICAL ENGINEER, upward age limit 45, to undertake supervisory duties concerned with the maintenance of electrical equipment used in the production of flexible packaging materials. Applicants must have had a sound fundamental training in electrical engineering, with practical experience of high and low voltage switchgear, power distribution and d.c. and a.c. variable speed drives with electronic control.

In particular, an extensive knowledge of electronic instrumentation and automatic controls as applied to industrial plant is necessary.

Please reply stating experience, age and salary required to:

Personnel Manager,
Theydon Rd,
Clapton,
London E.5.

(T 577)

LONDON ELECTRICITY BOARD

ASSISTANT DISTRIBUTION ENGINEER

APPLICATIONS are invited for the above position in the Board's Eastern District at 84 Romford Rd, Stratford, E.15.

Applicants should have a sound technical education to the standard of the Higher National Certificate and possess practical experience of engineering work associated with the organisation of a District distribution department.

The post is graded under Schedule A of the National Joint Board Agreement as Class J, Grade 12, £940 per annum rising to £1,065 per annum, inclusive of London Allowance.

Applications should be sent to the Manager at the above address, within 14 days of the publication date of this notice. Please quote ref.: PER/V/3200/T. (T 570)

CENTRAL ELECTRICITY GENERATING BOARD

PRINCIPAL ASSISTANT ENGINEER

REQUIRED in the Commercial Department at Headquarters, London S.E.1.

The duties will include the preparation of estimates of the cost of providing traction and other special supplies of electricity; of the value of supplies of electricity purchased and of the cost of providing steam supplies; the formulation of tariffs and preparation of heads of agreement for the foregoing sales and purchases and the investigation of the economic justification of schemes involving capital expenditure.

Candidates should have responsible experience on the commercial or economic aspects of electricity supply and should preferably possess an engineering degree or corporate membership of a senior engineering institution or equivalent qualifications.

Salary within the range £2,230/£2,440 p.a.

Applications stating age, qualifications, experience, present position and salary, to the Appointments Officer, 24-30 Holborn, London E.C.1, by 27 Feb. Envelopes should be marked "Confidential Ref. ET/56." (T 561)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

APPOINTMENT OF ESTABLISHMENTS OFFICER

APPLICATIONS are invited for the appointment of Establishments Officer in the department of the Secretary at this Board's Head Office.

Considerable experience in recruitment, control of establishments, industrial negotiation, joint consultation, application of wage agreements and personnel matters generally is essential. Practical experience of personnel administration within the Electricity Supply Industry would be an advantage. Salary: £2,595/£2,815 per annum in accordance with Grade B.8 (Scale 5) of the scheme of salaries of the National Joint Managerial and Higher Executive Grades Committee.

Appointment subject to medical examination. Pension Scheme.

Applications should be forwarded to me at Electricity Hse, Love La, Liverpool 3, by Friday, 24 Feb., 1961.

M. M. PARKER,
Secretary.
(T 568)

YORKSHIRE ELECTRICITY BOARD

No. 4 (Leeds) Sub-Area

THIRD ASSISTANT ENGINEER
(METERS, TESTING AND PROTECTION)

APPLICANTS should have had a sound technical education and possess the H.N.C. in electrical engineering or equivalent qualifications.

A keen interest in technical problems is essential and previous experience of metering or protection will be an advantage.

Salary: N.J.B. Class I, Grade 10 (Scale 10), £1,190/£1,325 per annum.

Applications, with the names of two referees, should be sent to the Manager, No. 4 (Leeds) Sub-Area, Yorkshire Electricity Board, Bramhope, Leeds, not later than 24 Feb., 1961. (T 558)

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT DISTRICT ENGINEER
CENTRAL SUSSEX DISTRICT

SALARY: £965/£1,090 p.a., under N.J.B. Class F, Grade 8. Superannuable. Applicants should be suitably qualified and have had training and experience in the construction, operation and maintenance of underground and overhead distribution systems. The successful candidate may elect to have a service tenancy of a Board's flat. Applications, quoting ET and naming two referees, to District Manager, Seeboard, Electra Hse, Church Rd, Haywards Heath, Sussex, by 22 Feb., 1961.

ASSISTANT ENGINEER
MEDWAY DISTRICT

Salary £965/£1,090 p.a. under N.J.B. Class G, Grade 9 (Scale 7). Superannuable. Applicants of good general education should have had technical training to Higher National Standard, with practical experience of general distribution work and be capable of giving assistance on planning, construction or maintenance work. Applications, quoting ET and naming two referees, on forms from District Manager, Seeboard, Gardiner St, Gillingham, Kent, by 22 Feb., 1961.

ASSISTANT (WAYLEAVES)
GUILDFORD DISTRICT

Salary under N.J.C. Grade 2, £700 x £25—£775 p.a. Superannuable. Applicants must have a good general education and be able to conduct negotiations with landowners, agents and public authorities for wayleaves for overhead lines and small substation sites. A knowledge of agriculture and of land values is desirable. Applications, quoting ET, on forms from District Manager, Seeboard, Woodbridge Rd, Guildford, Surrey, by 22 Feb., 1961.

GEORGE WRAY,
Secretary.
(T 563)

SOUTH WALES SWITCHGEAR LIMITED

Applications are invited for a Technical Sales Representative—switchgear training and qualifications to H.N.C. essential—must hold current driving licence. Successful applicant will be based at Wilmslow.

Apply stating age, qualifications, experience and salary required to: The Home Sales Manager, South Wales Switchgear Ltd., Rex Bldgs, Wilmslow, Cheshire, and mark the envelope "Confidential."

(T 516)

SENIOR ESTIMATING ENGINEER

required for London Office of National Contractor, capable of preparing tenders and designing all types of commercial and industrial installations. Bonus scheme in operation in addition to salary. Apply in writing giving full details of qualifications, age, experience, etc., or telephone for an appointment. Duncan Watson (Electrical Engineers) Ltd., 60 Worship St, E.C.2. Telephone No.: BIS. 4752.

(T 480)

WIREMEN

Vacancies exist for Wiremen able to work from circuit diagrams, and preferably with some experience of automatic instrumentation. Five-day week. Please apply to Director, Research and Development Division, Baird and Tatlock (London) Ltd., 14-17 St. Cross St, London E.C.1. (T 551)

BRITISH RAILWAYS

RAILWAY ELECTRIFIED LINES

OVERHEAD MAINTENANCE STAFF

Vacancies exist on the Eastern Region Electrified Lines in the London Area. Applicants selected will be engaged as Assistant Overhead Traction Linemen at a base rate of £9 18s per week. The average earnings for this grade amount to approximately £13 per week. Shift working is involved. Courses of instruction are given and good opportunities exist for promotion to higher grades. Certain free and reduced rate rail travel facilities. Pension and Sick Pay Schemes. Apply giving full particulars of age, experience, etc., to Electric Traction Engineer (London Area), British Railways, Eastern Region, Off Ley St, Ilford, Essex.

(T 518)

ENGLISH ELECTRIC

Application Engineers

Professional engineering appointments are available on a wide range of manufacturing and application engineering duties on all classes of electrical equipment.

Experience in manufacturing, power generation and supply or in the utilisation of electricity is the qualification sought and professional engineers in any of these fields are invited to apply for consideration.

A number of vacancies also exist for trained engineers seeking an opportunity of acquiring further experience and scope in this class of work.

All appointments are pensionable after a qualifying period.

Apply stating age, experience and qualifications to Department G.P.S., English Electric Hse, Strand, London W.C.2, quoting reference ET 497G.

(T 541)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

THE CULHAM LABORATORY

for Research into Controlled Thermonuclear Reactions

EXPERIENCED SERVICES ENGINEERS

are required for the New Laboratory now being built at Culham, near Abingdon. Berkshire.
The Services Engineers will be responsible to the Site Works Engineer for operating and maintaining site services at the Laboratory. They will be required to assist in the establishment of necessary facilities, including workshops and staff, and develop these to meet the needs of a growing site for minor works and maintenance.

There are two posts:

The first requires experience of the installation, operation and maintenance of H.V. and M.V. distribution networks and extensive power and lighting installations.

The second requires experience of the installation, operation and maintenance of site mechanical services, boiler house, ventilation equipment, water treatment plant, compressed air and gas supplies, etc.

You are invited to apply if you are a corporate member of a senior engineering institution or have an equivalent qualification and have considerable supervisory experience.

STARTING SALARY (according to experience) on a scale £1,560/£2,090 p.a.

Housing and contributory superannuation schemes.

Send a postcard for further details and application form to:
THE PERSONNEL OFFICER (CAP/40/08/49),
Culham Laboratory,
A.E.R.E. Harwell, Berks.

(T 534)

Training for Engineers
in the Electricity Supply Industry

The Electricity Supply Industry employs 18,000 electrical and mechanical engineers in all parts of England and Wales. They are responsible for generating electricity in the power stations, transmitting it over the Grid, and distributing it throughout the country. To keep this key force up to strength as older staff retire and sales of power rise, the industry needs each year to recruit several hundred young men to its technical training schemes.

Five-year apprenticeships are available to school-leavers who hold a good Ordinary level G.C.E., including maths. and a science, or two Advanced level passes in maths. and physics. Training is by means of planned practical experience, combined with day or "sandwich" release leading to an engineering qualification.

Two-year traineeships are offered to graduates holding a degree in electrical or mechanical engineering from a British university. Training provides extensive and varied practical experience and satisfies the requirement of the professional institutions.

Those who already possess an engineering Diploma may also be considered for practical training. This will be planned according to the previous experience of the trainee.

On satisfactory completion of training, all apprentices and trainees are guaranteed employment in this essential and expanding industry. A wide range of careers is available, in many types of engineering, including research and commercial development.

For further information write to:
The Education and Training Officer,
The Electricity Council, 13 Winsley St., London, W.1.

(T 579)

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION

APPLICATIONS are invited for post of ASSISTANT

in a Department at Ascot largely concerned with heavy rotating plant. The qualifications demanded of candidates, who should be aged not more than thirty and single, include:

A good education and an ability to write concise English.
A working knowledge of heavy rotating plant.

Personality and tact.

The position is permanent and pensionable. Applications, with full details of experience and stating present salary, should be addressed to the Secretary of The Association, 36 Kingsway, London W.C.2. (T 581)

THE EAST MIDLANDS ELECTRICITY BOARD
Derby and Burton Sub-Area

Vacancy No. 5/61.
DEMONSTRATOR

SALARY: N.J.C. Grade 1, 600 x £25—£700 per annum.

The successful candidate will be based at Derby, but will be required to operate throughtout the Burton, Derby and Uttoxeter Districts.

Applicants must be over 21 years of age and should hold the E.A.W. Electrical Housecraft Certificate for Demonstrators and be experienced in general Service Centre duties and be capable of conducting demonstrations and advising consumers on the selection and use of electrical appliances, both at the Service Centre and on Consumers' premises.

Ability to drive a motor vehicle will be an advantage.

Applications should be forwarded to the Manager, Derby and Burton Sub-Area, Electricity Offices, Irongate, Derby, in an envelope marked "Demonstrator," within 14 days of the date of this advertisement.

Area Board Headquarters

Vacancy No. 19/61.
SECOND ASSISTANT ENGINEER
(PLANNING AND DESIGN)

Salary: N.J.B. Class BX, Grade 5, £1,375/£1,720 per annum, or Grade 4, £1,465/£1,830 per annum, depending on the experience and qualifications of the successful candidate.

The successful applicant will be required to assist in the preparation of Schemes and Reports for the extension and reinforcement of the Board's 33 kV system. Some knowledge of substation design is also desirable.

Applications should be forwarded to the Chief Engineer, The East Midlands Electricity Board, Mapperley Hall, Lucknow Ave, Nottingham, within 14 days of the date of this advertisement. (T 571)

BP has a vacancy for an ELECTRICAL DRAUGHTSMAN at its Head Office in London. Applicants aged 25-35 should have completed an apprenticeship in Electrical Engineering and be in possession of at least O.N.C. (Electrical) or equivalent and have had experience on electrical installations for process plants, workshops and factories. This work will involve visits to Company installations in the U.K. and overseas. Salary according to age and experience. Non-contributory Pension Scheme. Removal and settling-in allowances payable in certain cases. Luncheon Club. Write, quoting reference H.5244B, to Box 6526, c/o Hanway Hse, Clark's Pl, E.C.2. (T 539)

CABLING JOINTER wanted, capable of jointing up to and including 11 kV and also, if necessary, to work on live cables. Must be willing to travel anywhere in the Midlands, Lincolnshire and Lancashire areas. Must be able to drive. Good rates of pay and working conditions.—Box No. 8155, Electrical Times. (T 412)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

ELECTRICAL Wholesalers have vacancy for ASSISTANT MANAGER. Only applicants with previous experience in similar business will be considered. Salary: £750/£1,000 according to ability. Full details to Box 8173, Electrical Times. (T 535)

ELECTRICIANS required for permanent appointments in electrical section of Borough Engineer's Department. Must have served apprenticeship and be fully skilled and versatile. Basic wage £11 4s 7d (5s 4½d per hour) five-day week. Applications in writing to Borough Engineer and Surveyor, Civic Centre, Southampton. (T 574)

ELECTRICAL. Experienced man for planning and estimating large-scale industrial and commercial installations. Good prospects in large and expanding organisation.—Lee Beesley, 119 Holloway Head, Birmingham 1. (T 580)

ELECTRIC CONTROL GEAR ENGINEER/DRAUGHTSMAN, experienced in Circuitry for Heating, Ventilating and Oil Burner Controls required by Consulting Engineers. Candidates should have at least a Higher National Certificate or Grad.I.E.E. Apply stating qualifications and experience to Kennedy and Donkin, 12 Caxton St, S.W.1. Ref.: FBT/WBH. (T 297)

GROUP of Companies need active man for plant dismantling projects throughout the U.K. Engineering/Commercial background useful. Based within 45 miles of London.—Box No. 8179, Electrical Times. (T 575)

HALSEY'S ELECTRIC CO. LTD., Brandon Hse, Wyfold Rd, Fulham, London S.W.6, require SALES ORDER CLERK of ability who has had previous experience in a similar capacity with an electrical wholesaler. This is a permanent position with a commencing salary of £700 p.a. Canteen facilities and excellent working conditions. (T 536)

HALSEY'S ELECTRIC CO. LTD., Brandon Hse, Wyfold Rd, Fulham, London S.W.6, require experienced SALESMEN, preferably with experience in a similar capacity with an electrical wholesaler. Our service both in respect of delivery and sales office attention to customer's orders is second to none. Representatives with established connections can be assured of a progressive future. (T 537)

JUNIOR AND ASSISTANT DRAUGHTSMEN, experienced for lighting and power schemes for office, school and hospital buildings. Age 20/25 years. Five-day week, three weeks' holiday. Consulting Engineers, Holborn Area.—Box No. 8125, Electrical Times. (T 205)

PLUMBER CABLE JOINTERS and MATES required for employment in London. Must be accustomed to working on live L.V. mains. London rates, plus E.T.U. conditions. Generous overtime. Interested applicants should ring Mr A. G. Bensley at Hillside 6940. (T 552)

SALES MANAGER with good office, administrative and field experience. Knowledge of elec. o/h line systems. Age 35 or thereabouts. Salary in accordance with experience. Apply Bowthorpe Electric Co. Ltd., Crawley, Sussex. (T 573)

SALES REPRESENTATIVE. — Applications are invited for an experienced Sales Representative for the London area. The position offers attractive future prospects and is pensionable. Applicants should have an intimate knowledge of the Electrical Wholesale Industry. Applications will be treated in the strictest confidence and should give details of past experience, age, etc., and should be addressed to The Manager, The Metallic Seamless Tube Co. Ltd., 88 Goswell Rd, London E.C.1. (T 530)

SALES CLERK, preferably with knowledge of electrical appliances required by Belling and Company Limited, Bridge Works, Enfield. Canteen facilities, Pension Scheme.—Apply Sales Manager. (T 531)

SALES REPRESENTATIVE, preferably with a knowledge of selling electric cookers and fires required for the North Eastern Area. Applicants should have a good personality and education, be a car owner and have sound contacts with the Area Boards, Electrical Wholesalers and Retailers in the area. Write giving age, qualifications and experience to Belling and Co. Ltd., Bridge Works, Enfield, Middlesex. (T 532)

TRANSFORMER Test and Design. A TEST ENGINEER required by small company for transformers up to 500 kVA. This would not be full time, and some time could be spent on design after suitable tuition. Man with H.N.C. preferred. The situation offers an excellent opportunity to a tester to learn design.—Box No. 8157, Electrical Times. (T 418)

PREMISES TO LET

BOROUGH OF HORNSEY
Lock-Up Shop to Let

APPLICATIONS are invited for the tenancy of a lock-up shop at No. 28 Veryan Court, Park Rd, N.8, at a rental of £225 per annum, exclusive of rates, for a 21 years' tenancy with option to terminate at seven years and 14 years. Further particulars and conditions of tenancy may be obtained from the undersigned.

W. B. MURGATROYD,
Town Clerk.
1 Feb., 1961. (T 543)

AGENCIES

BRITISH Associates of Scandinavian manufacturers of decorative lighting fittings and shares, etc., are now open to receive applications from first-class agents of all areas, including London and the Home Counties.—Box No. 8177, Electrical Times. (T 554)

WANTED

WANTED for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper Ltd., 17 Brady St, Bethnal Green, E.1. (T 1)

WORK WANTED

CABLE jointing, cable laying installations and any heavy industrial type of electrical installation carried out. All quotations are free and all work is guaranteed for 12 months. All inquiries to W. T. Parker Ltd., 113 Station St, Burton upon Trent, Staffs. Telephone No. 4831. (T 357)

METALWORK.—All types of cabinets, chassis, racks, etc., to your own specification. — Philpotts Metalworks Ltd., Chapman St, Loughborough. (T 11)

FOR SALE

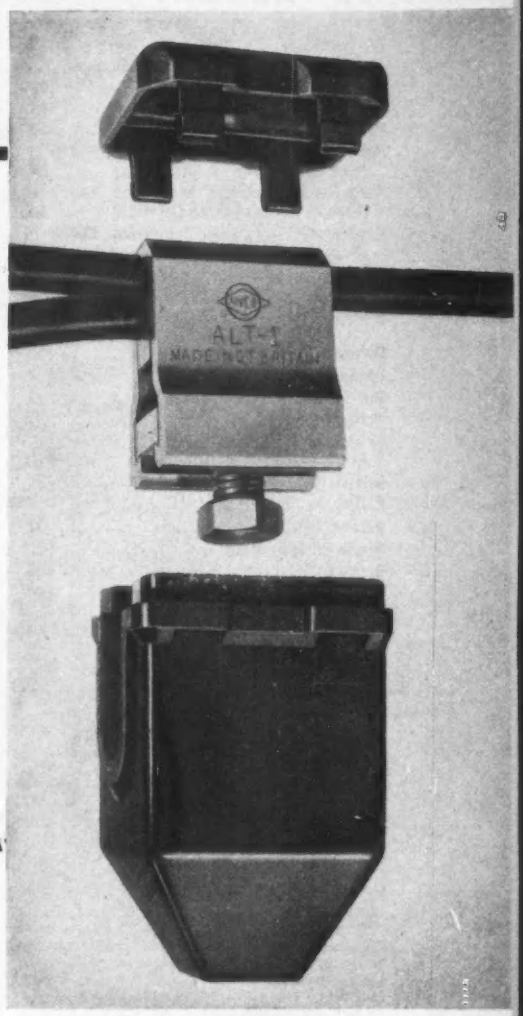
A.C. and D.C. SLOTMETERS: Time Switches and Quarterly Meters. Single and polyphase, 2½-100 amps. Tested and guaranteed 2 years. Television and Billiards Meters. — Tradex Meter Co., Surbiton. Elmbridge 2234/5/6. (T 9)

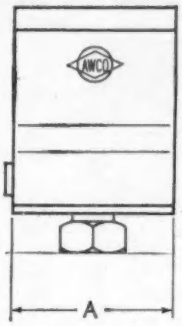
A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, Switchgear, Exhaust Fans, Hoists, Reduction Gears, new or reconditioned units.—CHI 5105, 67 Rothschild Rd, W.4. (T 3)

Classified Advertisements continued on page 52.

NEW from AWCO

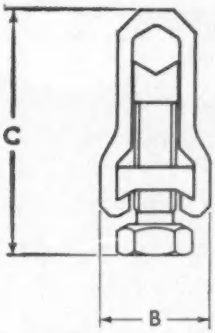
Efficient low-priced line-taps and insulating shrouds for connecting all types of **ALUMINIUM CONDUCTORS**



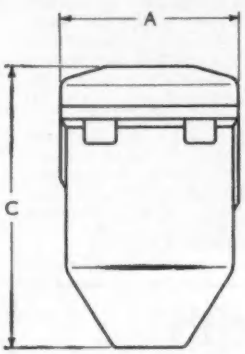


SADDLE TAP

For all-aluminium, ACSR and Silmalec† Conductors

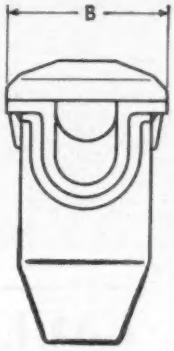


Catalogue Number	Main conductor diameter range	Maximum combined conductor diameters	A	B	C
	in.	in.	in.	in.	in.
ALT-1	0.177—0.366	0.732	1.300	0.875	2.375
ALT-2	0.367—0.558	1.038	1.875	1.175	3.250



INSULATING SHROUD

For ALT-1 saddle tap*



Catalogue Number	A	B	C
	in.	in.	in.
LTS-1	1.813	1.625	2.734
*LTS-2	Insulating shroud for ALT-2 Saddle tap available shortly		

AWCO offer all types of **ALUMINIUM CONDUCTORS** for overhead electrification including all-aluminium, ACSR and Silmalec† conductors — both bare and plastic-covered. Write to us for publications describing these conductors and their accompanying accessories for line erection and maintenance.

† registered trade mark.

ALUMINIUM WIRE & CABLE CO LTD Sales Office: 2 St. James's Square, London, S.W.1 Tel: TRA 6441
Branch Office: 13 Colmore Row, Birmingham, 3 Tel: CENTRAL 2407
Head Office & Works: Port Tennant, Swansea, Glamorgan Tel: SWANSEA 52251

AWCO

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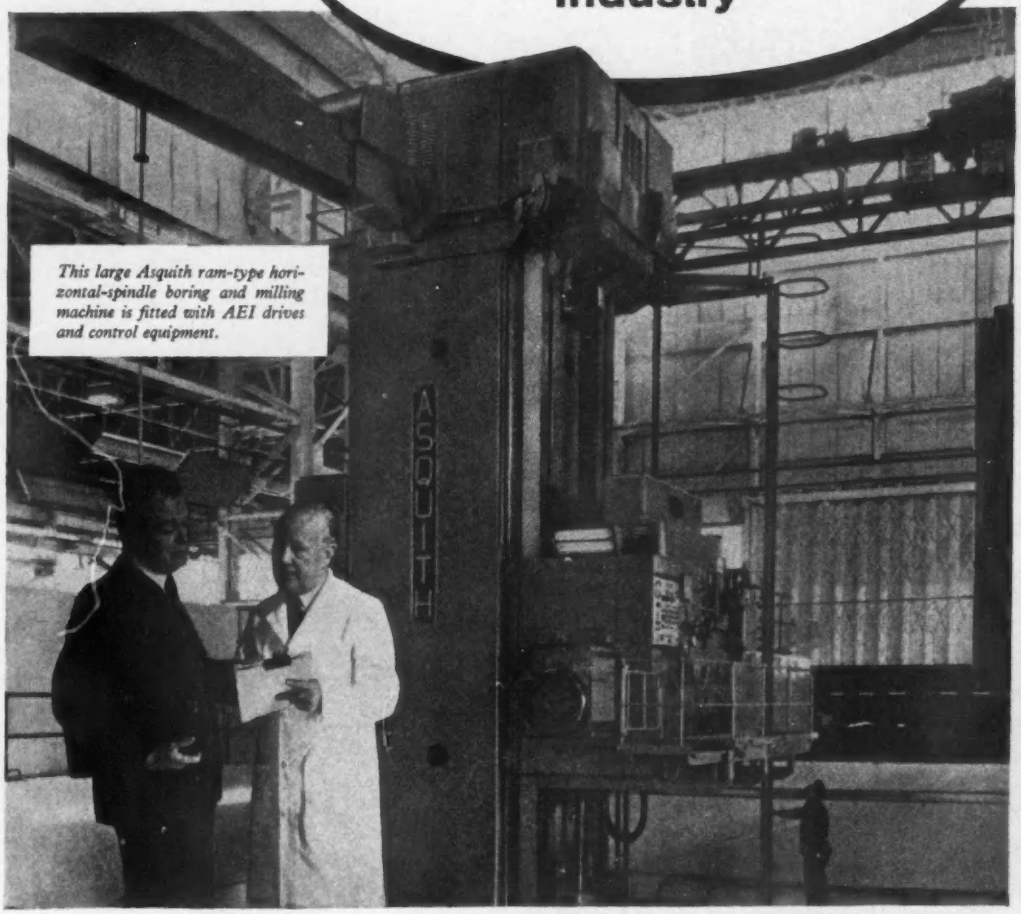

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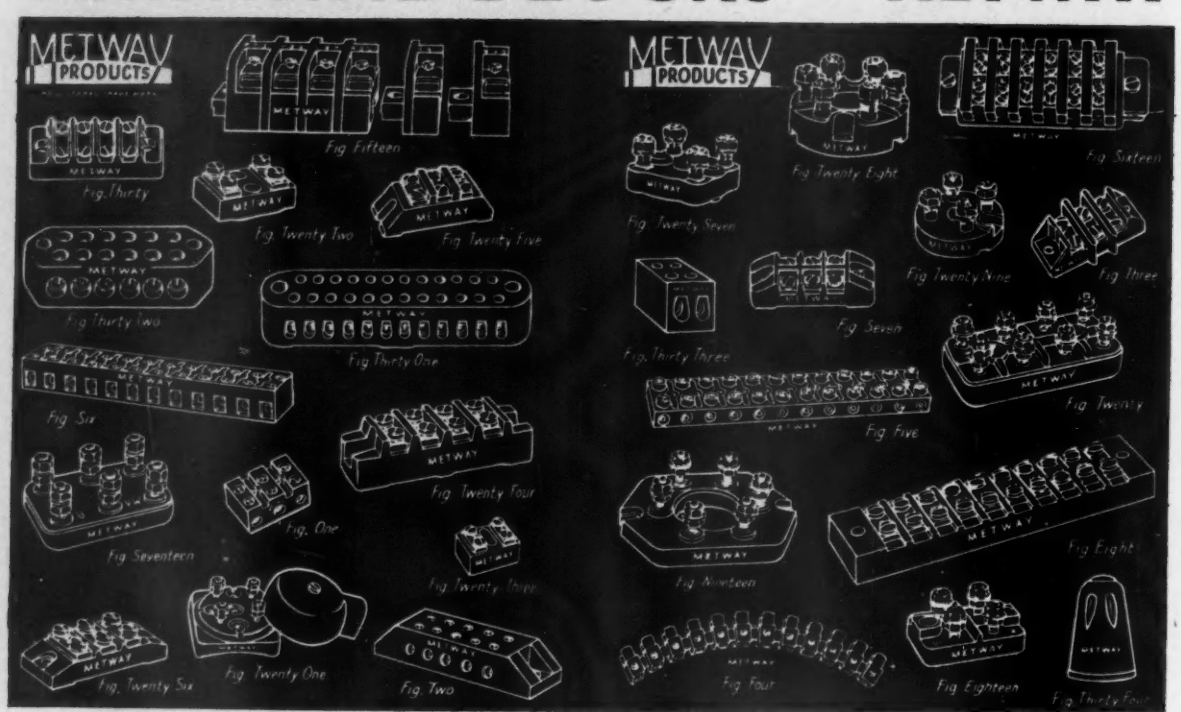

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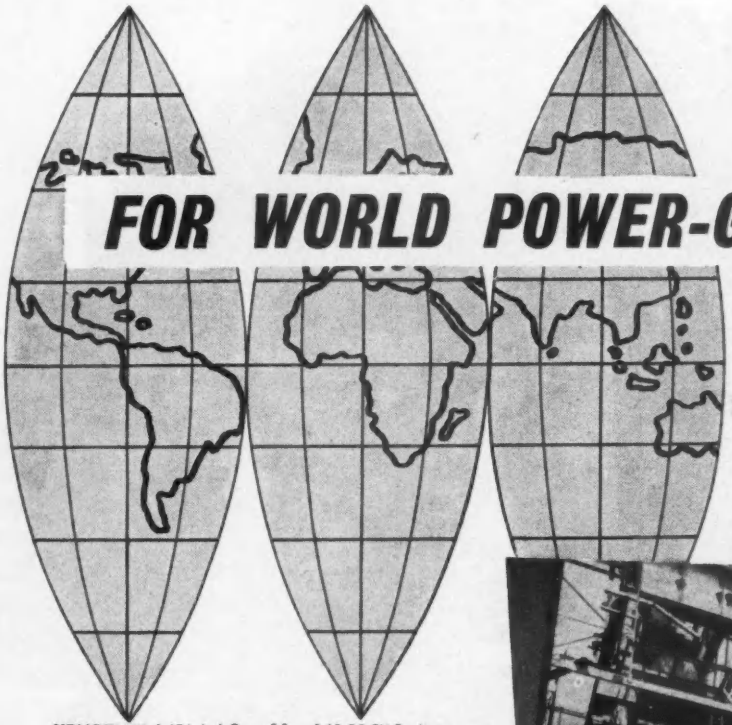

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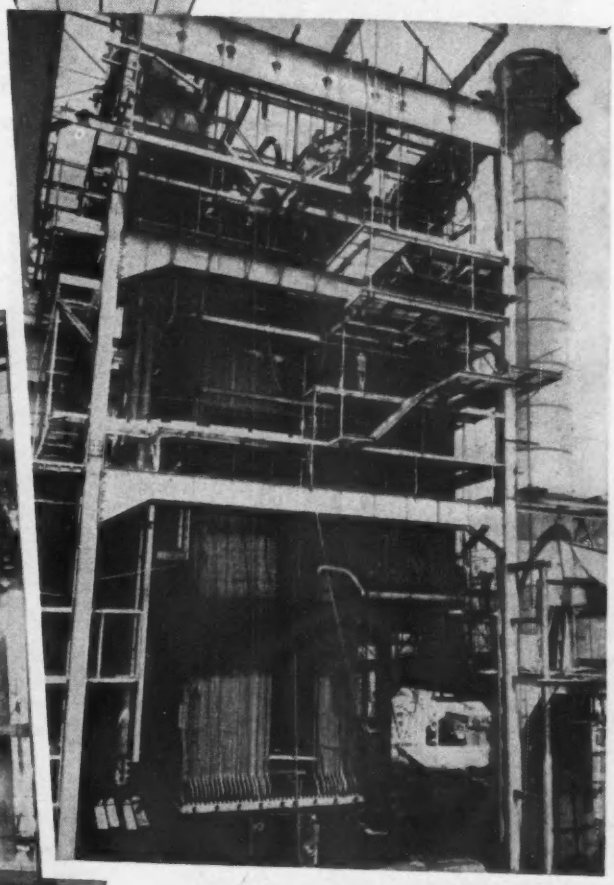

VENEZUELA (Right) *One of four BABCOCK Radiant boilers, natural-gas and oil fired, each rated at 550,000 lb./hr.; during erection for La Electricidad de Caracas. (Consulting Engineers: Sofina)*

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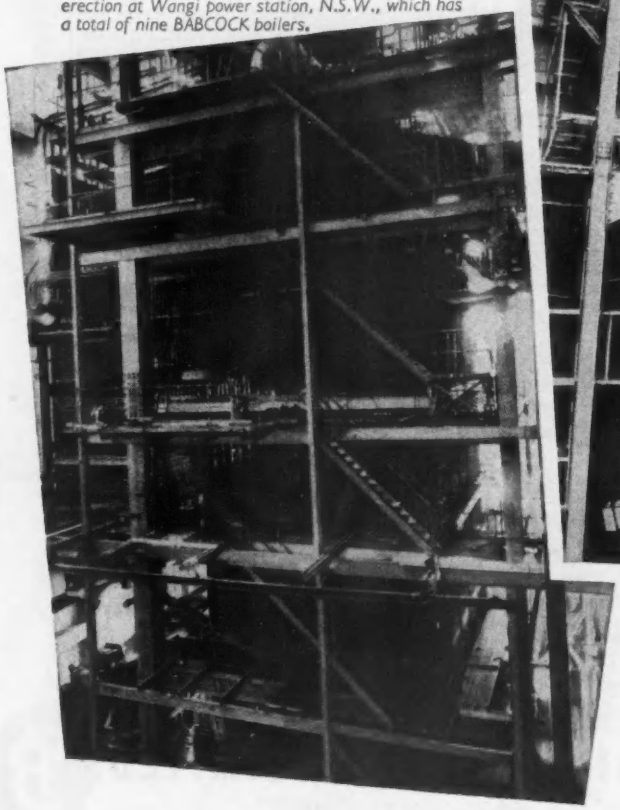

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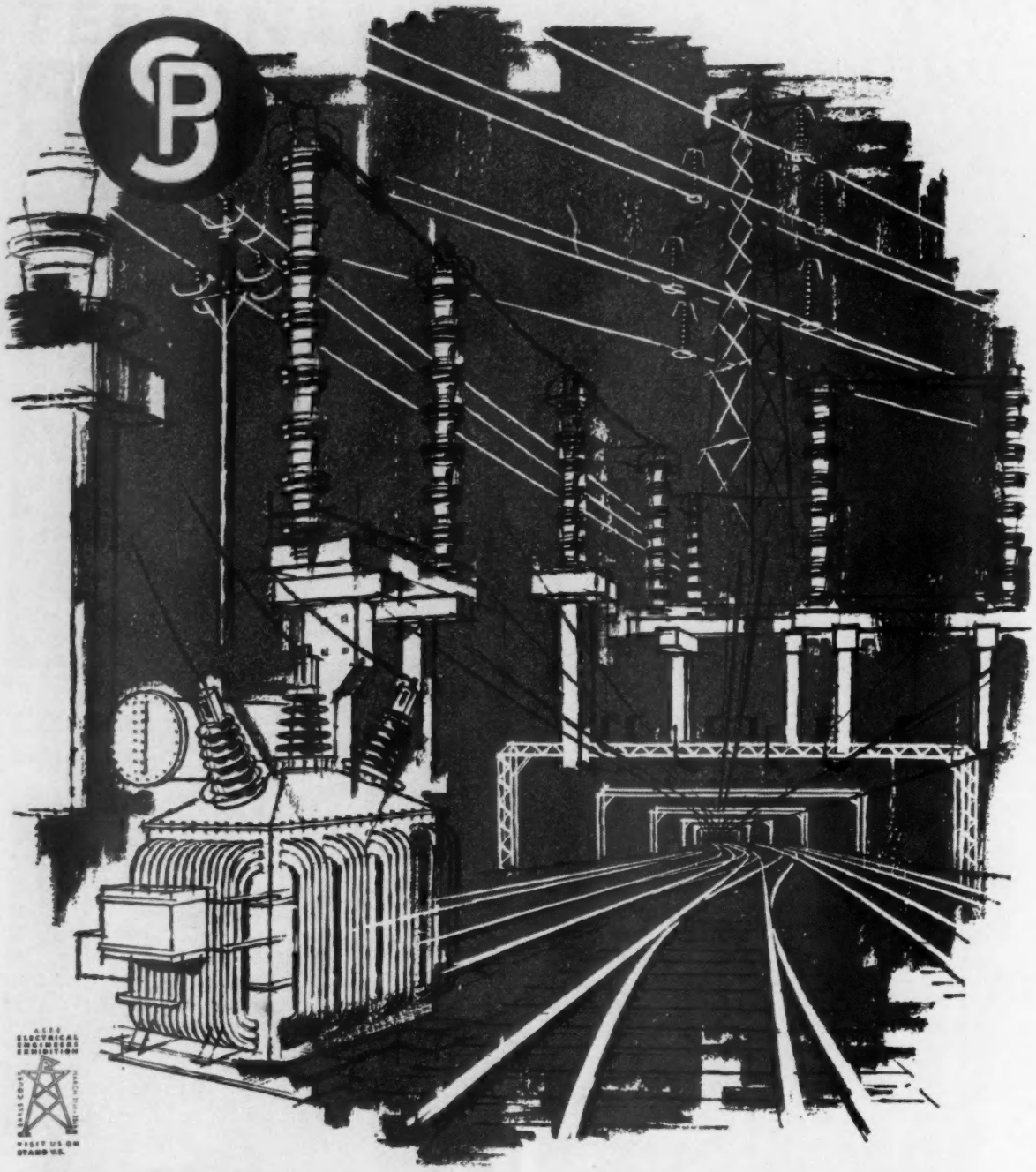

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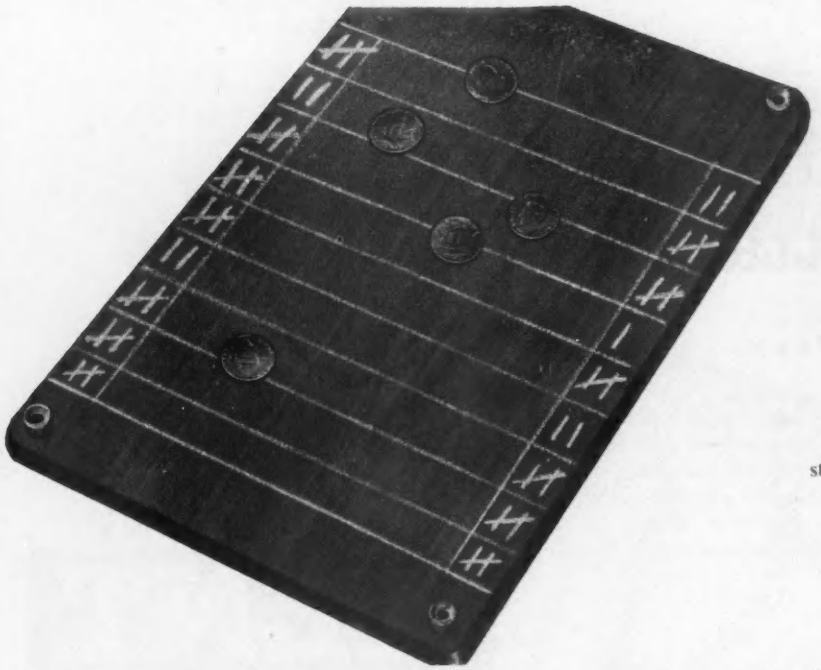

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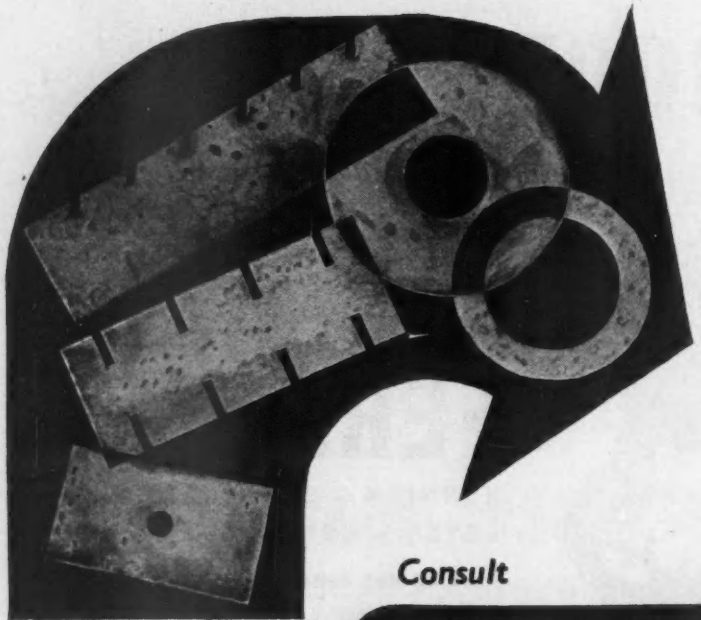

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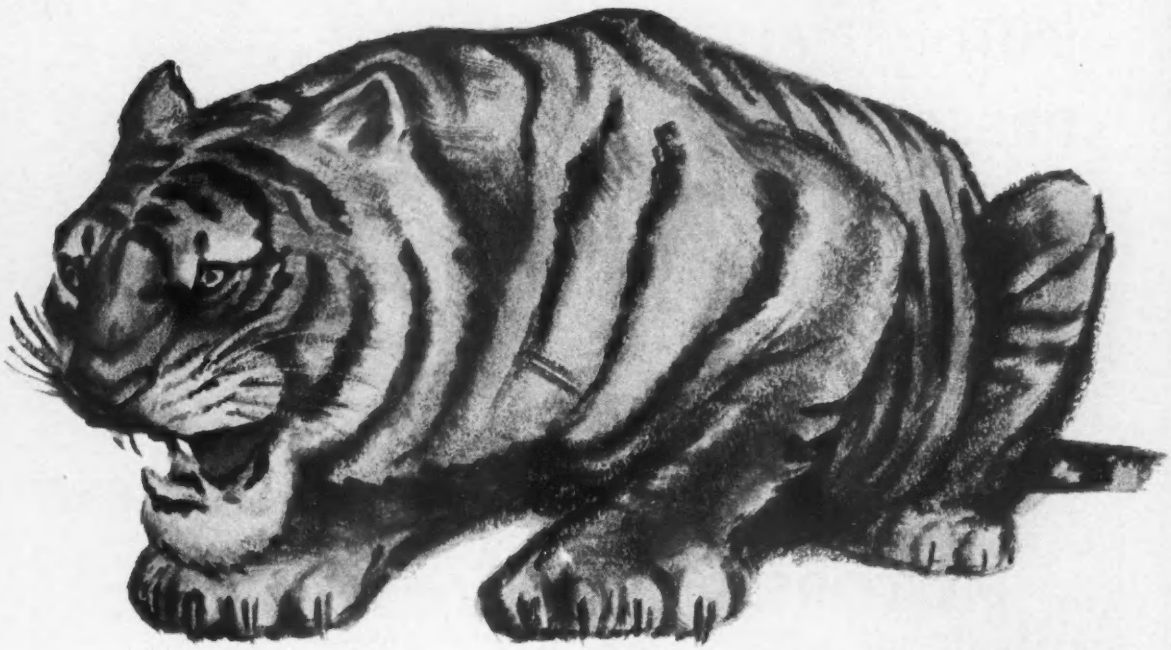

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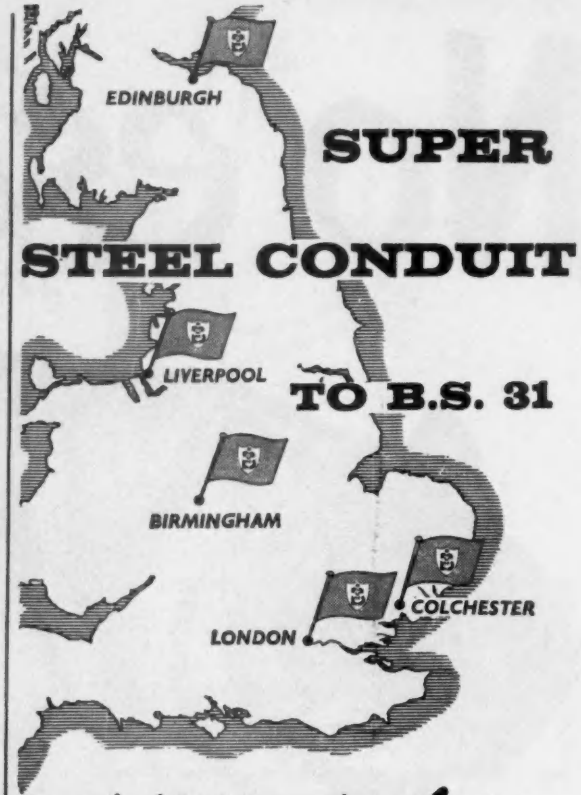

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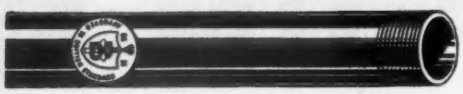

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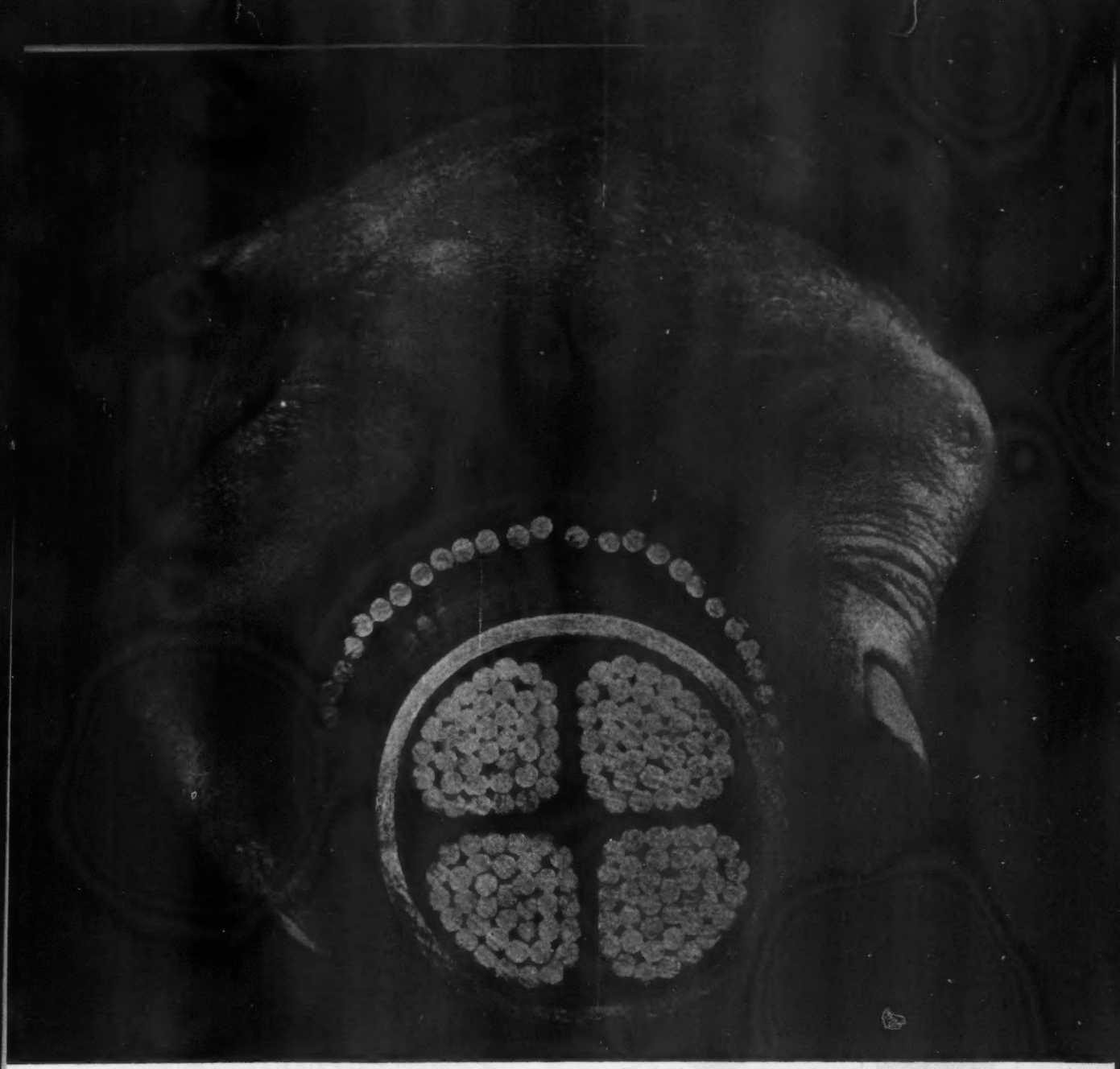

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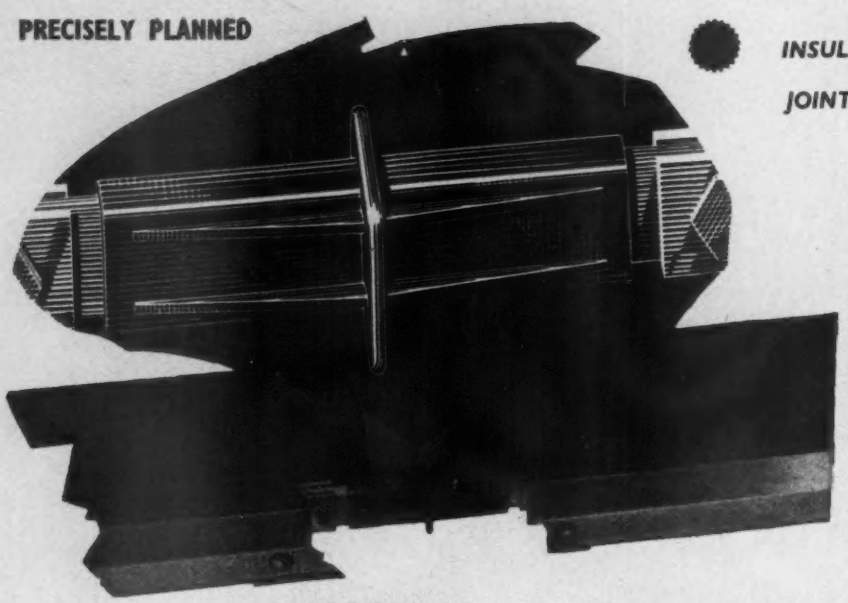

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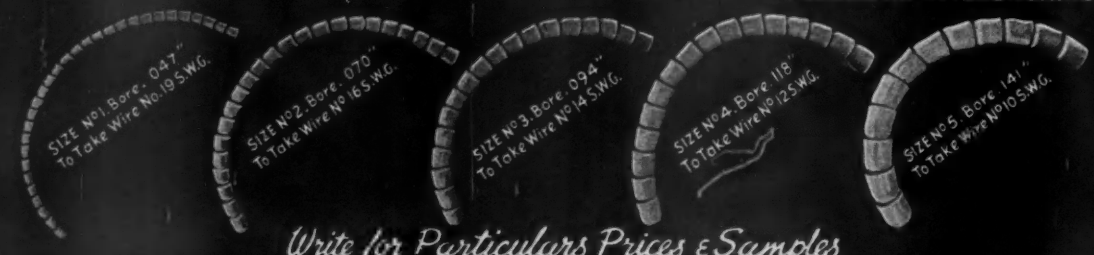
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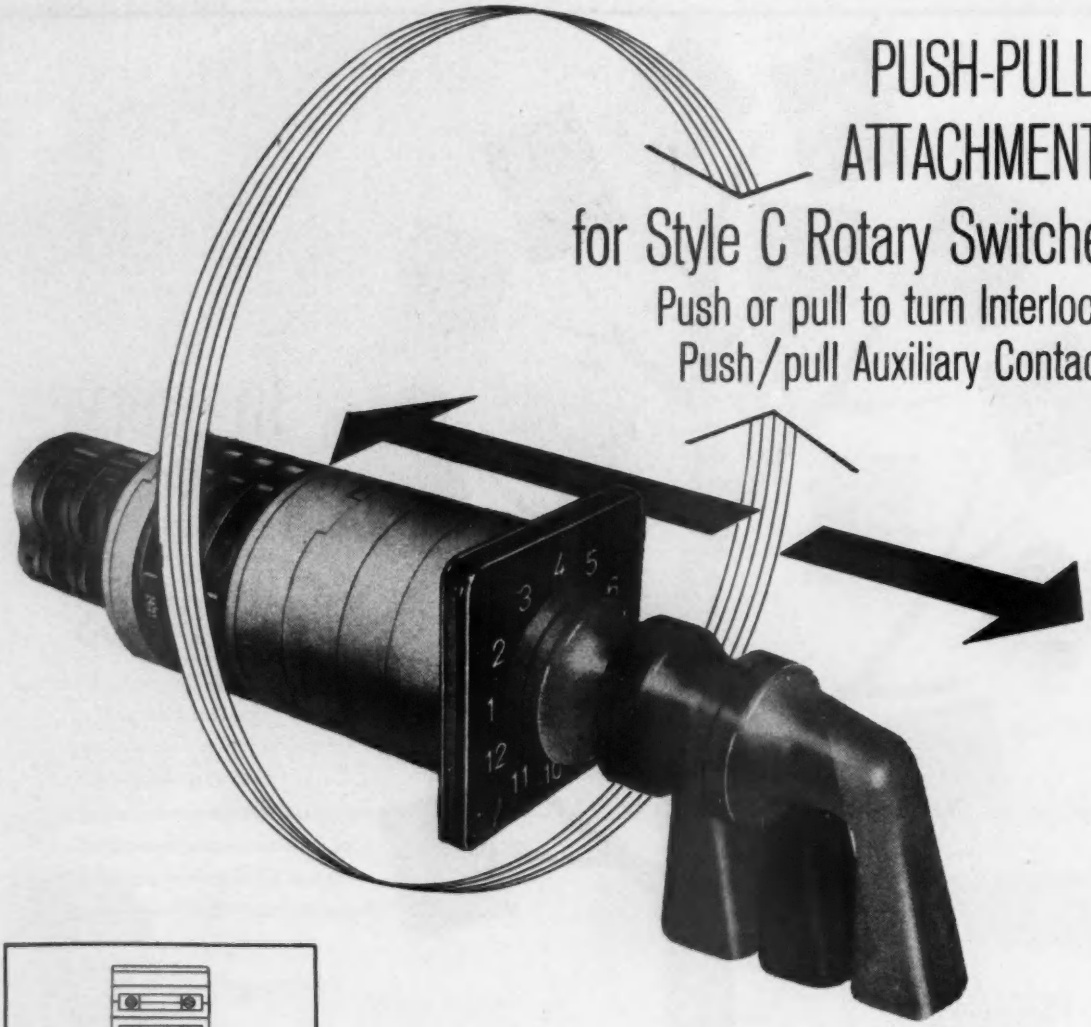

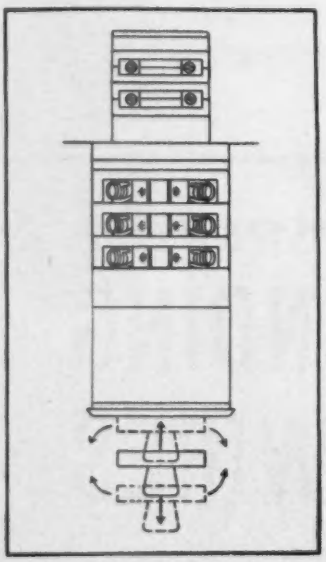

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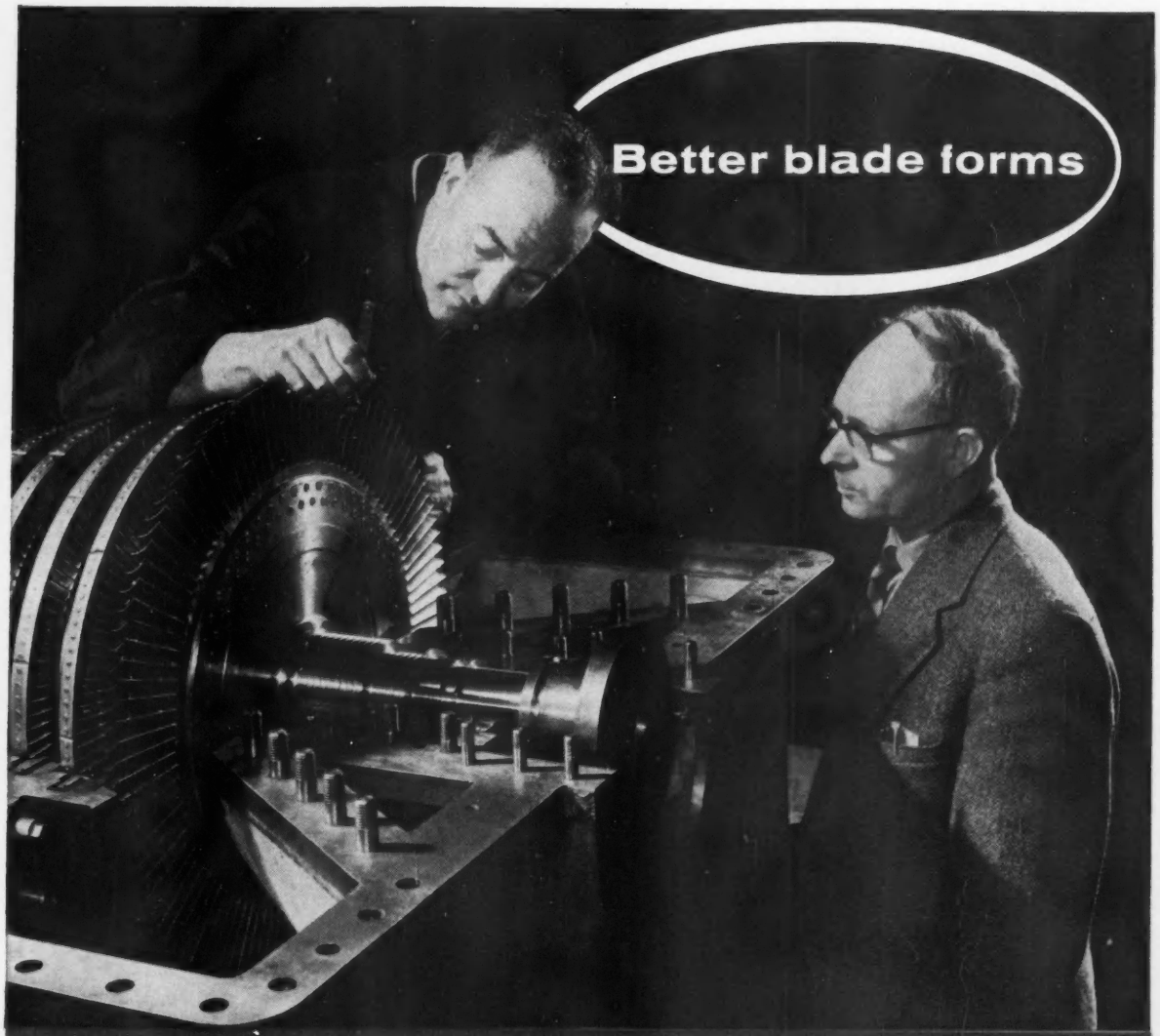

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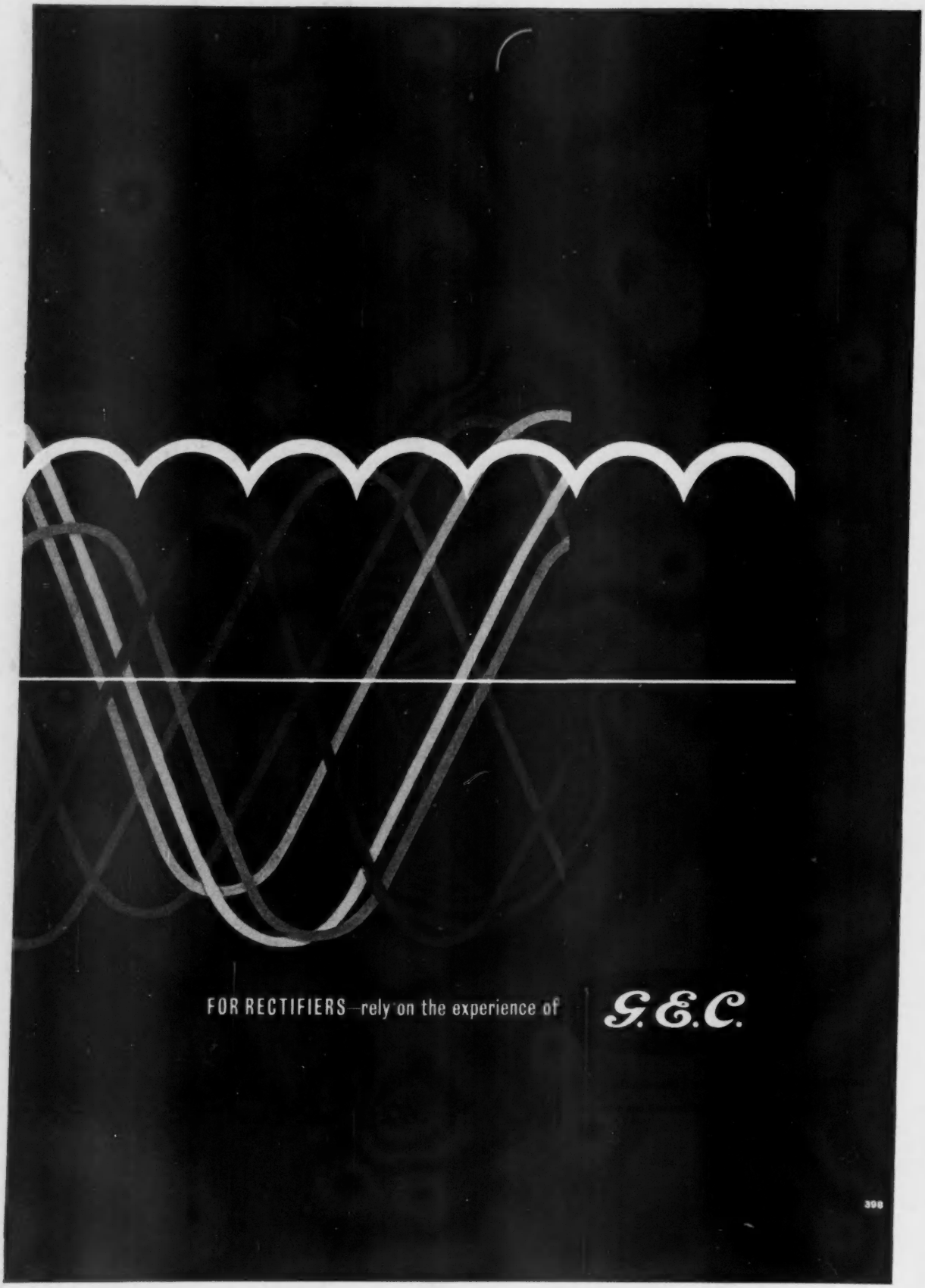
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